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2014 Annual Groundwater Monitoring Report

Palermo Wellfield Superfund Site
Tumwater, Washington

for

Washington State Department of Transportation

February 24, 2017

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1.0 INTRODUCTION

This annual report was prepared to summarize Spring (April) and Summer (August) 2014 semiannual groundwater monitoring results at the Palermo Wellfield Superfund Site (Site), U.S. Environmental Protection Agency (EPA) ID: WA 0000026534, located in Tumwater, Washington (Figure 1). This annual groundwater monitoring report was prepared for the Washington State Department of Transportation (WSDOT) in accordance with the requirements described in the Administrative Settlement Agreement and Order on Consent for Response Actions (ASAOC) Statement of Work (SOW), CERCLA Docket 10-2012-0149, entered into by EPA and WSDOT, effective July 6, 2012 (EPA, 2012).

WSDOT began groundwater monitoring in 2013. Before 2013, semiannual groundwater monitoring was conducted by the EPA as part of the remedy selected for the Site as documented in the Record of Decision (ROD) dated November 16, 1999 (EPA, 1999). In 2004, EPA began monitoring groundwater semiannually for tetrachloroethene (PCE) and trichloroethene (TCE) as part of the long-term monitoring program.

In the spring of 1999, EPA began operating an air stripping treatment system at the Palermo Wellfield (Wellfield) to remove TCE from groundwater. Operation and maintenance of the groundwater treatment system is the responsibility of the City of Tumwater (City) based on an agreement with EPA.

TCE and PCE also were detected in surface water samples from the base of the Palermo bluff where it ponded in the yards and crawl spaces of nearby homes within the Palermo Neighborhood (Neighborhood). A subdrain system and treatment lagoon were constructed in 2000 within the Neighborhood. The purpose of the system is to lower the local groundwater table beneath homes west of SE Rainier Avenue and remove the TCE and PCE from the collected water (Figure 2). Following the construction and verification of subdrain and treatment lagoon performance period, a maintenance program was established and implemented by the Washington State Department of Ecology (Ecology). Ecology monitored the subdrain and lagoon system performance between 2002 and 2008. In November 2009, EPA assumed the lead for the performance monitoring of the subdrain and treatment lagoon system. The subdrain system includes a subgrade perforated piping network installed behind the seven southern-most houses west of SE Rainier Avenue. The main perforated pipe or "trunk drain" is beneath the backyards of the houses. Groundwater accumulated in the perforated pipe flows to an unperforated "tightline" pipe beneath SE Rainier Avenue and SE M Street. The tightline pipe drains to a treatment lagoon located at the Municipal Golf Course. PCE and TCE are removed from the water by surface aeration before it is discharged to the Deschutes River by way of an existing water course. WSDOT has been conducting subdrain and lagoon monitoring since 2013.

From 2004 to present, annual reports have been prepared for groundwater monitoring and subdrain and treatment lagoon monitoring programs. This document represents the annual groundwater monitoring report in accordance with the SOW outlined in the ASAOC between the EPA and WSDOT dated July 2012.

2.0 SCOPE OF WORK

Under Section C4 of the ASAOC Statement of Work (SOW), this annual report summarizes and analyzes data collected from groundwater sampling events conducted during 2014, presents trend data, describes unusual conditions, provides recommendations, and presents a discussion of the capture zone. This annual report also includes a summary of operations and maintenance activities pertaining to the subdrain and treatment lagoon system. These activities were generally completed for the 2014 monitoring events using procedures presented in the following documents:

- *Field Sampling and Analysis Plan – Semiannual Groundwater Monitoring, Palermo Wellfield Superfund Site (FSP)* (GeoEngineers, 2013a).
- *Operation and Maintenance Manual Subdrain System* and *Treatment Lagoon Palermo Wellfield Superfund Site (O&M Manual)* (URSG, 2002).
- *Addendum 1 Operation and Maintenance Manual Subdrain System and Treatment Lagoon, Palermo Wellfield Superfund Site* (GeoEngineers, 2013b).
- *Addendum 2 Operation and Maintenance Manual Subdrain System and Treatment Lagoon, Palermo Wellfield Superfund Site* (GeoEngineers, 2014a).

Activities completed include:

- Collection of groundwater water samples from 52 monitoring locations during Spring 2014 and 45 locations during Summer 2014.
- Collection of water samples from nine subdrain and treatment lagoon locations.
- Measurement of sediment accumulation and discharge rate at 12 subdrain and treatment lagoon locations.

This annual report provides a summary of the groundwater data obtained from the Spring and Summer 2014 sampling events in accordance with ASAOC SOW.

3.0 GROUNDWATER

This section presents information on semiannual field activities, analytical results, concentration trends, and discusses the groundwater capture zone of the Wellfield.

3.1. Semiannual Field Activities

Field activities conducted during the semiannual monitoring events included collection of the following number of samples:

Location Type	Spring 2014	Summer 2014
Monitoring Wells	29	29
Shallow Groundwater Piezometers	15	12
Seeps	4	0
Wellfield Locations	4	4

Attributes of monitoring locations and groundwater level elevations observed during the Spring and Summer 2014 sampling events are presented in Tables 1 and 2 and Figures 3 and 4. Field forms associated with the sampling are provided in Appendix A. Specific details about the monitoring locations are described below. Deviations from the FSP are outlined in the Section 3.1.5.

3.1.1. *Monitoring Wells*

Groundwater from 29 monitoring wells was sampled as identified in the FSP (GeoEngineers, 2013a). Samples were generally collected using a portable Grundfos submersible pump at monitoring wells with the exception of monitoring wells MW-93-02 and MW-96-17 which were sampled using a peristaltic pump and an internal hand pump, respectively. Field parameter measurements were recorded using a multi-parameter water quality meter and a turbidimeter.

3.1.2. *Shallow Groundwater Piezometers*

Groundwater from 15 piezometers during Spring 2014 and 12 piezometers during the Summer 2014 sampling events were sampled in accordance with the FSP with the exception of piezometer PZ-709, discussed in Section 3.1.5. Piezometer groundwater samples were collected using a peristaltic pump after field parameter stabilization.

3.1.3. *Seeps*

Four groundwater seep samples were collected from locations near the base of the bluff and from a drainage ditch located west of the Wellfield during Spring 2014 (Figure 2). These samples were collected using a peristaltic pump after collecting three sets of field parameters. With consultation of EPA, no seep samples were collected for the Summer 2014 sampling event.

3.1.4. *Wellfield Locations*

Two production wells and one air stripper tower associated with the active treatment system were sampled at the Wellfield during 2014. Consistent with the FSP, no field parameters were collected from these three locations. Production well TW-16 was also sampled during both events. It is not presently connected to the treatment system so similar equipment and methodology used to collect samples for monitoring wells was used to sample this location.

3.1.5. *Deviations from the Groundwater Monitoring FSP*

The list outlined below is specific to deviations from the FSP which occurred during 2014.

- For both monitoring events, MW-96-17 and MW-93-02 were not sampled with a submersible pump. Monitoring well MW-96-17 was sampled using a permanent internal down-hole pump maintained by the City. A peristaltic pump was used to collect the sample from MW-93-02 because an obstruction (stick) was present in the well casing. The stick was partially removed from the casing by the City during the Fall 2013 monitoring event, but could not be completely extracted.

- The City wells MW-96-15 and MW-96-16 contain a different brand of submersible pump (QED Micropurge pump) which is not compatible with the Grundfos submersible pump system. These pumps were removed before sample collection and then replaced after sampling was completed for both the Spring and Summer monitoring events.
- Piezometer PZ-709 did not yield sufficient water to purge until field parameters stabilized during the Spring 2014 event. The piezometer was allowed to recharge for approximately an hour. After recharging, the piezometer provided enough water for sample collection without field parameter stabilization. Similar methodology was used to collect a groundwater sample at monitoring well MW-ES-04 which also did not yield enough water for parameter stabilization during the Summer 2014 event.
- One of the air stripper towers (ST-1) was sampled during both monitoring events because the other tower (ST-2) was offline.
- Production well TW-5 was not sampled during 2014 because it was decommissioned in January. Monitoring at this location has been discontinued.
- Groundwater samples were collected from production well TW-16 at the request of EPA during 2014.
- A piping upgrade was performed by the City during the summer in which the sample port for production well TW-4 was removed. For the Summer 2014 monitoring, the sample from TW-4 was collected in the treatment building at the blended influent line after the other production wells were turned off. Groundwater from TW-4 was allowed to flow through the system for approximately 5 to 10 minutes to flush the line before a sample was collected. Until a port is re-installed in the well house, groundwater from TW-4 will continue to be collected at this location using similar methodology.
- Monitoring well MW-ES-08 was not sampled as part of the 2014 monitoring program, because it is now located within Lake Park Drive SW as a result of recent land development nearby. Collecting samples at MW-ES-08 would require a partial lane closure and traffic control. Groundwater monitoring at this location has been temporarily discontinued (Zavala, 2014).
- Monitoring at four seeps (SEEP-1 through SEEP-3, and SEEP-5) and three piezometers at the base of the bluff (PZ-704, PZ-709, and PZ-715) was discontinued in Summer 2014. (Zavala, 2014).
- The lake water level was measured at the Barnes Lake staff gauge (Table 2). The gauge is located northeast of the current WSDOT Materials Testing Laboratory and is maintained by the City.
- Semi-annual groundwater monitoring was performed generally one month before semi-annual groundwater monitoring is typically performed. This was completed in an effort to correspond field activities and collect groundwater data during the 4th air monitoring event in the Neighborhood.

3.2. Groundwater Monitoring Analytical Results

This section describes the results of the laboratory analysis completed for the Spring and Summer 2014 sampling events including a data quality assessment, comparison to ROD cleanup goals, and a brief description of the results from each of the four sample location types. Tabulated analytical data are included in Appendix B. Data validation reports are presented in Appendix C. Laboratory analytical reports are presented in Appendix D. Table 3 and Figures 5 through 8 summarize PCE and TCE concentrations at the groundwater monitoring locations.

3.2.1. *Data Quality Assessment*

Data quality for both the Spring and Summer 2014 semiannual groundwater sampling was found to be acceptable, as qualified. A detailed assessment is provided in the data validation reports in Appendix C.

3.2.2. *Groundwater Record of Decision Cleanup Goals*

Site groundwater chemicals of concern identified in the 1999 ROD are PCE and TCE (EPA, 1999). Analytical results discussed below were evaluated against the ROD remediation goals (RGs) for these chemicals. ROD RGs for PCE and TCE are both 5 micrograms per liter (µg/L), the maximum contaminant level (MCL) for drinking water as referenced in the Federal Clean Water Act.

3.2.3. *Monitoring Wells*

PCE and TCE were the primary VOCs detected in groundwater which is consistent with historical sampling results. The maximum concentration of PCE detected in groundwater was located at MW-ES-04 for both 2014 events at 34 µg/L during the Spring and 16 µg/L during the Summer sampling event. The maximum concentration of TCE detected in groundwater was located at MW-ES-09 for both 2014 events at 110 µg/L during the Spring and 100 µg/L during the Summer. Both PCE and TCE detected in groundwater exceeded the 5 µg/L RG at some locations as shown on Figures 5 through 8.

Additional compounds detected in samples from monitoring wells in August included cis-1,2-dichloroethene (cis-1,2-DCE) at a concentration of 0.38 µg/L and 0.4 µg/L at MW-UI and MW-ES-09, respectively. No additional compounds were detected in groundwater samples from monitoring wells during the spring sampling.

3.2.4. *Shallow Groundwater Piezometers*

Similar to monitoring wells, the shallow groundwater piezometer results were relatively consistent with historical results. PCE and TCE analytical results for the piezometers are presented in Figures 5 through 8.

PCE was detected in groundwater samples from two piezometers in the Neighborhood during 2014 at piezometers PZ-720 and RPZ-731. Concentrations of PCE at these two piezometers ranged from 0.23 µg/L to 0.94 µg/L. Concentrations of PCE in groundwater samples from other piezometers were below the 5 µg/L site RG.

TCE was detected in groundwater at about half of the piezometers in the neighborhood during both 2014 monitoring events. Spring 2014 TCE groundwater results were generally lower in concentration than summer and ranged in concentration from 0.65 µg/L to 37 µg/L. The Summer 2014 TCE groundwater results ranged in concentration between 1.5 µg/L to 61 µg/L. TCE concentrations in groundwater samples from three of these piezometers (PZ-720, PZ-721, and PZ-724) continue to be greater than the 5 µg/L RG.

Cis-1,2-DCE was detected in three piezometers during both Spring and Summer 2014 sampling events. Groundwater samples from PZ-721, PZ-724 and PZ-728 contained concentrations of cis-1,2-DCE ranging in concentration from 0.23 µg/L to 0.92 µg/L in the spring and not detected to 0.90 µg/L in the summer.

3.2.5. *Seeps*

PCE and TCE were not detected in samples collected at the four seep locations during the Spring 2014 sampling event (Figures 5 through 8). Seeps locations were not sampled during Summer 2014. No additional compounds were detected at the seeps locations for 2014.

3.2.6. *Wellfield*

TCE was detected at one of the two water supply wells sampled during the Spring and Summer 2014 sampling events. Both spring and summer TCE concentrations in groundwater samples from production well TW-4 (0.43 and 0.89 µg/L, respectively) were below the ROD remediation goal of 5 µg/L before treatment through the air stripper.

TCE was detected in the groundwater sample from production well TW-16 during both spring and summer sampling events at a concentration of 9.6 µg/L and 19 µg/L, respectively. Production well TW-16 was completed in 2012 and has not been connected to the treatment system. These TCE concentrations are above the site RG of 5 µg/L.

PCE and TCE were not detected in the effluent sample collected from Stripper Tower ST-2. No additional compounds were detected at the Wellfield locations.

3.3. Mann-Kendall Trend Test

The Mann-Kendall trend test was used to evaluate changes in PCE and TCE concentrations at selected monitoring locations on the Site over time. Trend test results are presented for monitoring locations where PCE or TCE were detected. Generalized results from the trend test are presented in Table 4. The Mann-Kendall trend test was performed using groundwater monitoring data collected since 2004 when long-term monitoring began at the Site. The tests were performed using the EPA software package ProUCL, using a 95 percent confidence limit. Concentrations of PCE and TCE did not demonstrate a statistically significant increasing trend at any of the monitoring locations using the Mann-Kendall trend test. The trend test does indicate a statistically significant decreasing trend in concentrations of PCE or TCE at 13 monitoring wells, 2 piezometers, and production well TW-4. Basic trend plots have been provided in Appendix E for comparison.

3.4. Capture Zone

A preliminary capture zone analysis was performed and included in the *Draft Revised Summary of Existing Information Report* (GeoEngineers, 2015). The capture zone analysis is included in Appendix F.

The City has shared that the Wellfield has recently been operating intermittently and at lower capacity because of the following circumstances:

- Fewer production wells are active at the Wellfield. Two production wells have been recently abandoned and two production wells have recently been installed (one each in 2012 and 2014), but are not yet active.
- The City's water supply needs are being met by other water sources. We understand the Wellfield's lower yield is temporary until new production wells are connected to the treatment system.

3.5. Conclusions

Conclusions are provided in the following subsections.

3.5.1. *Monitoring Wells*

Discussion of conclusions surrounding the monitoring wells focuses on results and general trends.

3.5.1.1. RESULTS

PCE and TCE in groundwater samples from monitoring wells appears to be similar in concentration between Spring and Summer 2014 (Figures 5 through 8). Groundwater samples collected from monitoring wells MW-ES-04 and MW-ES-06 exceeded the PCE 5 µg/L ROD RG for both sampling events and appear to be limited to the area between the present O'Reilly Auto Parts and Brewery City Pizza. Detectable concentrations of TCE appear to be less localized. TCE exceeding the ROD RG of 5 µg/L extends from MW-UI on the southwest corner of the intersection of Trosper Road and Littlerock Road to the well pair MW-ES-09 and MW-ES-10 at the intersection of SE Rainier Avenue and SE O Street in the Neighborhood.

3.5.1.2. TRENDS

Groundwater from many of the monitoring wells has been monitored for years such that concentrations can be evaluated over time. The Mann-Kendall trend test performed on monitoring well groundwater analytical data show that concentrations of PCE and TCE are not detected, stable or decreasing at each location where chemicals of concern have been detected and sufficient data have been collected to perform the Mann-Kendall trend test. The results of the Mann-Kendall test indicate concentrations of PCE and TCE are not increasing. Groundwater samples from two monitoring wells, MW-ES-04 and MW-ES-06, contain concentrations of PCE that exceed the 5 µg/L remediation goal. On the basis of the Mann-Kendall trend test, the concentration of PCE at monitoring well MW-ES-04 is decreasing. Concentrations of PCE in groundwater samples from monitoring well MW-ES-06 do not show a statistically significant trend. Groundwater samples from 13 monitoring wells contain concentrations of TCE that exceed the 5 µg/L remediation goal. Of these, 11 locations show decreasing concentration trends. Of the monitoring wells where decreasing concentrations of PCE and TCE were not statistically supported, concentrations were either stable, or insufficient data have been obtained to establish a statistically significant trend.

3.5.2. *Shallow Groundwater Piezometers*

Similar to the monitoring wells, conclusions for the piezometers focus on results and also discuss extent.

3.5.2.1. RESULTS

PCE and TCE concentrations at the piezometers were similar between the Spring and Summer 2014 monitoring events. With the exception of the groundwater samples collected from piezometer PZ-720 and RPZ-732, PCE was not detected in groundwater samples from the piezometers at concentrations exceeding laboratory reporting limits. Concentrations of PCE were detected below ROD RGs from PZ-720 and RPZ-732 during both events. The location of PZ-720 is generally near the intersection of SE Rainier Avenue and SE N Street where PCE is has been detected in the subdrain. Historical evidence of PCE detected in groundwater near RPZ-732 were observed in the past and in January 2014 as part of the Shallow Groundwater Investigation (GeoEngineers 2014c).

TCE was detected at concentrations that exceed the ROD RG in shallow groundwater samples in three locations during the spring and summer. Two of these locations, PZ-721 and PZ-724 are also near the intersection of SE Rainier Avenue and SE N Street. The third PZ-728 is located on SE Palermo Avenue.

Inferred isoconcentration contours developed using TCE analytical results from groundwater samples from the piezometers are presented on Figures 6 and 8.

3.5.3. *Seeps*

Seep samples collected during the Spring 2014 semiannual monitoring period did not contain detectable concentrations of PCE or TCE. These results are consistent with samples collected from the same locations in 2012 and 2013.

3.5.4. Wellfield

TCE and PCE were not detected in water samples collected from the stripper towers during monitoring performed in 2014. During Spring 2014, the Wellfield was not operating, which provided an opportunity to observe water levels and collect groundwater samples in the Neighborhood under non-operational conditions. These conditions yielded similar analytical results between spring and summer monitoring events when the system was operating. Conclusions from the Wellfield are mainly related to operations and capture zone.

3.5.3.1. OPERATIONS

Based on our current understanding of Wellfield operations, three of the original six production wells that were evaluated as part of the remedy remain active and produce water for public consumption. The City has decommissioned two of the production wells (TW-2 and TW-5) while a third (TW-3) remains inactive and awaits further assessment. The City installed one new production well (TW-16) in 2012 and another production well (TW-17) in 2014. Groundwater from production well TW-16 was analyzed in 2012 and contained TCE at a concentration of 19.5 μg/L, greater than the ROD RG of 5 μg/L. Groundwater samples were collected from production well TW-16 in Spring and Summer 2014. PCE and TCE were not detected in a sample collected from production well TW-17 collected in January 2014. We understand the City plans to provide a connection to the treatment system for both TW-16 and TW-17 in the coming few years to increase production of the Wellfield.

3.5.3.2. CAPTURE ZONE

As indicated in the capture zone analysis discussion, the City is undergoing a Wellfield redevelopment and expansion program to increase production at the Wellfield. During this redevelopment and expansion program, the Wellfield has not continually operated. The Wellfield and treatment system were identified by EPA as key components of the site remedy. Changes to the Wellfield that may impact the capture zone analysis will continue to be presented in the annual groundwater monitoring report.

4.0 SUBDRAIN AND TREATMENT LAGOON

The purpose of the subdrain and lagoon system is to lower the groundwater depth beneath the homes west of SE Rainier Avenue to at least 18 inches (1.5 feet) below the bottom of the crawlspaces or 3 feet below ground surface (URSG, 2002). This increase in groundwater depth aims at reducing the risk of vapor intrusion into the homes from shallow groundwater containing PCE and TCE. Shallow groundwater collected in the subdrain is conveyed via a tightline pipe and treated via surface aeration at the treatment lagoon before it leaves the lagoon (Figure 2). The following sections describe the field activities, results, and conclusions for the subdrain and treatment lagoon performance monitoring.

4.1. Field Activities

Field activities performed during the two 2014 monitoring events were generally similar, however, the spring event contained a much more robust data collection and evaluation of the subdrain operations. Amendment 2 to the O&M Plan was implemented for the spring monitoring (GeoEngineers, 2014a) whereas the primary site O&M Plan was used for performance of the summer monitoring (URSG 2002 and GeoEngineers, 2013b). Specific details about the field activities for the Spring 2014 monitoring can be found in the *Draft Subdrain System and Treatment Lagoon Investigation* document (GeoEngineers 2014b). Field activities that are common to both sampling events at the subdrain, tightline, and treatment lagoon are discussed in the following sections.

4.1.1. *Subdrain and Tightline*

The subsurface subdrain located behind the seven southern-most houses on the western side of Rainier Avenue SE collects shallow groundwater though an underground perforated pipe and conveys the water to the treatment lagoon through a solid tightline pipe. This section describes performance monitoring for this portion of the remedy and includes sampling, water elevation monitoring, discharge rate measurements, and sediment accumulation monitoring.

4.1.1.1. SAMPLING

Subdrain cleanout samples were collected using a polyethylene dipper by lowering the cup portion into each of the cleanouts, placing it under the outfalls, or by submerging it into the water. Similar procedures were used for collecting catch basin water samples as part of the Spring 2014 monitoring. Samples were submitted to the same laboratory as the groundwater samples under the same chain of custody procedures, and for the same analyses.

4.1.1.2. WATER ELEVATION MONITORING

Depth to water measurements were collected from the Neighborhood piezometers, the subdrain cleanouts and the tightline catch basins using an electronic water level indicator. The measurements were used to calculate groundwater elevations in the Neighborhood (Table 5 and Figures 9 and 10).

4.1.1.3. WATER FLOW RATE MEASUREMENTS

Flow rate was measured using a Greyline Stingray Portable Level Velocity Logger during the Spring 2014 monitoring event (GeoEngineers, 2013b) and a Global Flow Meter as outlined in the primary site O&M Manual (URSG, 2002). Discharge was calculated to equate to gallons per minute (gpm). Figures 11 and 12 and Tables 6A and 6B show the discharge volumes encountered in the subdrain.

4.1.1.4. SEDIMENT ACCUMULATION MONITORING

Total depth measurements were collected using an incrementally marked measuring rod placed inside of each subdrain cleanout and tightline catch basin to assess the sediment accumulated in the subdrain cleanouts and tightline catch basins. Table 7 summarizes the estimated depth of sediment in these structures in comparison to the original surveyed structure bottom.

4.1.2. *Treatment Lagoon*

Treatment lagoon performance is measured semiannually with respect to sampling and flow rate and once a year for sediment accumulation. Semiannual monitoring occurs at multiple lagoon inflows, treatment lagoon effluent, and a compliance point at the Deschutes River, whereas sediment accumulation monitoring occurs on an annual basis at the treatment lagoon.

4.1.2.1. INFLOWS TO LAGOON

The treatment lagoon receives water from four monitored sources:

- Station 350 – M Street Storm Drain Outfall
- Station 356 – Upstream Watercourse Inflow from the Wetlands
- Station 360 – Tightline Outfall to Treatment Lagoon
- Station 362 – M Street Terminus Catch Basin Outfall

These locations were monitored using the Greyline Stingray and Global Flow Probe, a rigid incrementally marked tape measure, and dipper for sample collection. The flow probe was used to measure flow rate by placing the probe at the outfall entrance and recording the flow rate. The water level in each outfall was measured using the tape measure. Tables 6A and 6B summarizes the discharge from each of the locations. A sample was also collected from each of the stations (if flowing) by placing the dipper into the discharge.

4.1.2.2. TREATMENT LAGOON EFFLUENT

Treatment lagoon samples were collected using a polyethylene dipper by lowering and submerging the cup portion into the spillway water. Samples were submitted to the same laboratory as the groundwater samples under the same chain of custody procedures, and for the same analyses.

The treatment lagoon effluent (Station 361) is monitored while aeration is actively occurring. Because the lagoon spillway is armored with rip rap, discharge is measured at an outfall approximately 800 feet downstream at a pond located north of the Tumwater Athletic Club where a more accurate flow rate can be determined (Tables 6A and 6B).

4.1.2.3. POINT OF COMPLIANCE

The point of compliance (Station 364) is located at the Deschutes River Outfall located approximately 2,000 feet downstream from the treatment lagoon. This location was monitored and sampled using the same equipment and measuring tools described in the preceding sections. Discharge rate for this station also appears in Tables 6A and 6B.

4.1.2.4. SEDIMENT ACCUMULATION MONITORING

Annual sediment accumulation monitoring occurs during the fall monitoring event at three transects through the lagoon. The depth to the base of the lagoon is measured at each of these transects from a boat at 2 foot intervals using a rigid, incrementally marked measuring rod and then compared to the original surveyed lagoon depth. Appendix G shows the comparison for the annual monitoring.

4.1.3. *Deviations from the Subdrain and Treatment Lagoon O&M Amendment and QAPP*

The following have been noted as deviations with respect to the Subdrain and Treatment Lagoon O&M Amendment and QAPP:

- Flow rate at Station 356 was not obtained during the Spring and Summer 2014 monitoring period because this area upstream of the lagoon has become wide and slow and could not be accessed safely.
- Flow rates and samples were not collected at Station 362 for both Spring and Summer 2014 because no water was present at this location. This is not an uncommon occurrence for this outfall.

4.2. Subdrain and Treatment Lagoon Monitoring Analytical Results

This section describes the results of the laboratory analysis completed for the Spring and Summer 2014 sampling events. The data validation reports are presented in Appendix C. Laboratory analytical reports are presented in Appendix D. Tables 6A and 6B and Figures 5 through 8, 11 and 12 summarize PCE and TCE concentrations in groundwater samples collected from piezometers surrounding the subdrain, the subdrain itself, and treatment lagoon locations.

4.2.1. *Data Quality Assessment*

Data quality for both the Spring and Summer 2014 semiannual O&M monitoring was found to be acceptable. A detailed assessment is provided in the data validation reports in Appendix C.

4.2.2. *Piezometers*

The piezometers of interest relative to the subdrain are located near the bluff and in SE Rainier Avenue. TCE and PCE were not detected in piezometers PZ-704, PZ-709, and PZ-715 near the bluff during Spring 2014.PCE was detected once near the subdrain at PZ-720 in SE Rainier Avenue for both the Spring and Summer 2014 monitoring events. TCE was detected at three of four piezometers in SE Rainier Avenue. Concentrations of TCE at PZ-720 and PZ-721 equaled or exceeded the ROD RG for groundwater during both semiannual events and ranged from 5.5 to 61 µg/L. Higher concentrations of TCE occurred during the fall. Additional details on analytical results for the Neighborhood piezometers are presented in Section 3.5.2.

4.2.3. *Subdrain*

Concentrations of PCE and TCE were detected in the subdrain during both monitoring events. PCE was detected in seven of the eight cleanouts sampled during the spring and ranged from 4.6 to 10 µg/L. PCE was also detected at the three cleanouts sampled in the summer and ranged in concentration from 4.3 to 12 µg/L.

TCE was detected in water samples from the cleanouts during the Spring 2014 monitoring and ranged in concentration from 8.8 µg/L to 12 µg/L. TCE was detected at all three of the cleanouts during the summer event ranging in concentration from 6 to 10 µg/L. No PCE or TCE was detected at the southern-most location, Cleanout CO-8, while just TCE was detected at Cleanout CO-7 to the north.

4.2.4. *Treatment Lagoon*

Monitoring locations for the treatment lagoon are discussed by location including inflows, effluent, and point of compliance.

4.2.4.1. INFLOWS

Inflow results for the treatment lagoon are briefly summarized by location below and in Tables 6A and 6B.

- **Station 350 – M Street Storm Drain Outfall:** TCE was detected during spring and summer at 1.2 µg/L or less. PCE was not detected at concentrations greater than the detection limit.
- **Station 356 – Upstream Watercourse from Wetlands:** PCE and TCE were not detected during either monitoring event.

- **Station 360 – Subdrain Tightline Outfall**: PCE and TCE were detected during both monitoring events. PCE was detected at similar concentrations of 4 and 4.4 µg/L between spring and summer, respectively. TCE was detected at the same concentration 11 µg/L for both monitoring events.
- **Station 362 – M Street Terminus Catch Basin Outfall:** Samples were not collected because there was not flow during both spring and summer.

4.2.4.2. LAGOON EFFLUENT

PCE concentrations of 0.3 µg/L in lagoon effluent samples collected post-aeration were slightly greater than the PCE reporting limit during both sampling events. TCE concentrations were 0.96 µg/L in the spring and 0.82 µg/L in the summer.

4.2.4.3. POINT OF COMPLIANCE

At the point of compliance located at the Deschutes River, TCE was detected at a concentration of 0.5 µg/L for both the spring and summer monitoring. PCE was not detected during the spring, however, it was detected at a concentration of 0.2 µg/L during the Summer 2014 monitoring.

4.2.4.4. RECORD OF DECISION SURFACE WATER DISCHARGE CLEANUP GOALS

Surface water discharge cleanup goals are based on the remedial action objective for groundwater ponding as surface water in neighborhood backyards. The objective is to prevent discharge of groundwater containing PCE and TCE in excess of the surface water RG to the Deschutes River. Remediation goals at the point of compliance (Deschutes River) are 0.8 µg/L for PCE and 2.7 µg/L for TCE.

4.3. Conclusions

To better discuss observations and results, the conclusions have been grouped together by monitoring element such that piezometers, subdrain, tightline, treatment lagoon and effluent, and point of compliance are discussed separately.

4.3.1. *Piezometers*

Water level elevations at the piezometers in SE Rainier Avenue were used to measure reduction in groundwater elevation to determine compliance with the O&M Plan. Groundwater depth in the piezometers in SE Rainier Avenue ranged from about one foot above ground surface (artesian) at the south end (PZ-722) to over 2.8 feet below ground surface during the spring in piezometer PZ-720. The summer monitoring period yielded similar results between artesian conditions to water levels exceeding 4 feet below ground surface in SE Rainier Avenue (Figures 9 and 10). A reduction in water table surface elevation to 1.5 feet below the bottom of the crawlspaces (or 3 feet below ground surface) was not achieved for the southern portion of the subdrain during both the spring and summer monitoring periods (Table 8).

Crawlspace depth below ground surface under houses west of SE Rainier Avenue is not uniform based on observations from recent air monitoring in the Neighborhood. In addition, the piezometers used for measuring depth to groundwater are generally located approximately 50 to 100 feet from the nearest crawlspace access. The distance between the subdrain and the nearest crawlspace access is approximately 10 to 20 feet. Groundwater monitoring points closer to houses may provide more representative groundwater depth for comparison to the performance criterion for the protection of human health.

4.3.2. *Subdrain and Tightline*

This section discusses conclusions relative to the subdrain and tightline and is further divided into discussion on results, discharge rates, and sediment accumulation.

4.3.2.1. RESULTS

PCE and TCE concentrations continue to be the highest in groundwater from Stations 357 (CO-6), 358 (CO-4), 359 (CO-1) and 360 (Figures 11 and 12). The highest concentrations of PCE in water samples collected from the subdrain during Spring 2014 were measured at Station 357 (CO-6) and the highest for TCE during the same period was at Station 358 (CO-4). Similar conditions were encountered during the Summer 2014 monitoring.

4.3.2.2. DISCHARGE RATES

Flow rates ranged from 23 to 2,419 gpm as summarized on Tables 6A and 6B and general observations relative to each location. Slow flow, soft bottoms, and organic matter were encountered at multiple locations during both spring and summer monitoring. Because this is a closed system, the discharge from Station 359 at Cleanout CO-1 should be more or less equivalent to the discharge into the treatment lagoon at Station 360. The discrepancy in discharge between the two locations was observed for both 2014 monitoring events and is consistent with past observations since the subdrain monitoring began in 2002.

4.3.2.3. SEDIMENT ACCUMULATION

One location (Cleanout CO-8) exceeded the 0.5-foot threshold for sediment accumulation during both the spring and summer monitoring (Tables 6A and 6B). Cleanout CO-4 also exceeded the same threshold during the summer monitoring. (Table 6B).

4.3.3. *Treatment Lagoon*

Similar to the preceding section, the treatment lagoon has been divided into separate elements for ease in discussion which include the inflows to the lagoon, the effluent, the compliance point, and sediment accumulation.

4.3.3.1. INFLOWS TO THE TREATMENT LAGOON

Sediment accumulation at each of the three outfalls was not observed during the 2014 monitoring period and flow does not appear to be hampered by the large grasses surrounding the outfalls. PCE was not detected in the samples from Station 350 or 356 indicating these locations are not contributing sources to the treatment lagoon. However, TCE was detected in the samples from Station 350 (SE M Street Storm Drain Outfall) at 1.2 µg/L in Spring 2014, and 1 µg/L in Summer 2014. The source of the TCE in the storm drain is unknown.

4.3.3.2. TREATMENT LAGOON EFFLUENT

PCE was detected during both Spring and Summer 2014 at Station 361 (lagoon effluent) at a concentration of 0.3 µg/L for both events. TCE was also detected at 0.95 µg/L and 0.82 µg/L in the treatment lagoon effluent samples collected during the spring and summer events, respectively.

4.3.3.3. POINT OF COMPLIANCE – DESCHUTES RIVER

Station 364 was added to the monitoring network in 2003 to allow further evaluation of the RG at the location where treated water discharges to the Deschutes River. This station is located where the treated water and water from other drainage ways in the area discharge to the Deschutes River, approximately

2,000 feet downstream from the treatment lagoon. PCE and TCE concentrations at Station 364 were not detected or did not exceed the RG of 0.8 μg/L for PCE and 2.7 μg/L for TCE for the 2014 monitoring period.

4.3.3.4. SEDIMENT ACCUMULATION

Sediment accumulation measured on the three transects in the treatment lagoon is presented in Appendix G. It should be noted that the last data points (right side of charts) collected for each lagoon transect measuring event may vary due to the lagoon water level observed during the specific monitoring year.

When compared to previous sediment accumulation monitoring, the summer measurements indicate that sediment has generally accumulated along each of the three transects. Based on the transect plots, the elevation of the base of the lagoon appears to be 0.5 to 2.5 feet higher than earlier measurements in some locations since the previous monitoring in October 2013.

5.0 RECOMMENDATIONS

Based on the results of the 2014 groundwater monitoring activities, provided are recommendations for future groundwater monitoring activities at the Site.

- Remove MW-96-16 and MW-96-17 from ongoing monitoring. These monitoring wells appear to be outside the area of PCE and TCE impacts from the Site. In addition, they are routinely monitored by Thurston County, which has shared past data.
- Remove either WDOT-MW-1 or WDOT-MW-2 from the ongoing monitoring network. Both monitoring wells are screened at same elevation and PCE and TCE have not been detected during any monitoring events.
- Decrease ongoing groundwater and subdrain monitoring frequency to one time every nine months. This will allow data that will provide varying seasons (four seasons in three years) to evaluate whether there are seasonal variations in data.
- Continue monitoring the Barnes Lake staff gauge during the semi-annual sampling events.

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TABLES

GeoEngineers

Table 1

Well Construction Summary

2014 Annual Groundwater Monitoring Report
Palermo Wellfield Superfund Site
Tumwater, Washington

Well or Piezometer	Well Location [1,2] Northing	Well Location [1,2] Easting	Measuring Point (TOC) Elevation [3]	Screen Interval Depth (feet bgs) Top	Screen Interval Depth (feet bgs) Bottom	Geologic Unit of Screen Interval	Approximate Screen Interval Elevation Top	Approximate Screen Interval Elevation Bottom
Bluff Area								
MW-UI	616967.53	1038149.35	178.82	17.7	27.7	unknown	161.1	151.1
WDOT-MW-1	617640.30	1038503.60	166.94	30.0	39.5	SP–dense to medium dense, olive green, fine sand	136.9	127.4
WDOT-MW-2	617572.60	1038517.40	165.45	30.0	39.5	SP–very dense, olive green to orange, fine to medium sand	135.5	126.0
MW-100	616814.53	1037366.22	177.70	20.0	30.0	SP-medium dense, brown, fine to coarse sand	157.7	147.7
MW-101A	617236.76	1038149.35	176.19	65.0	75.0	SP-loose, gray, fine to medium sand	111.2	101.2
MW-101B	617197.00	1038150.00	176.25	25.0	35.0	SP-loose to medium dense, light brown, fine to medium sand	151.3	141.3
MW-102	617465.24	1038134.22	166.94	16.0	26.0	SP-loose to medium dense, gray, fine to medium sand	150.9	140.9
MW-103	617768.90	1038225.10	163.74	11.0	21.0	SP-loose to medium dense, gray, fine to medium sand	152.7	142.7
MW-104A	617861.70	1039673.00	170.64	119.0	129.0	SP-medium dense to dense, brown, fine sand	51.6	41.6
MW-104B	617866.01	1039675.67	170.51	52.0	62.0	SP-medium dense, brown, fine grained sand	118.5	108.5
MW-109	617312.79	1038552.35	168.89	64.5	74.5	SP-medium dense to dense, brown, fine to coarse sand	104.4	94.4
MW-111	617663.43	1038824.43	165.41	30.0	40.0	SP-medium dense, brown, fine to medium sand	135.4	125.4
MW-ES-01[4]	617877.2	1039204.0	173.50	90.0	100.0	SP-outwash sands with silt	83.5	73.5
MW-ES-02	617664.68	1039666.61	174.65	95.0	105.0	SM-silty sand	79.7	69.7
MW-ES-03	617546.79	1039463.97	175.07	113.0	123.0	SP to SP-SM-sand with silt	62.1	52.1
MW-ES-04	617548.74	1039477.60	175.11	50.0	60.0	SM/ML/SM-silty sand, sandy silt, silty sand	125.1	115.1
MW-ES-05	617517.36	1039178.92	175.05	86.0	96.0	SP-SM-fine sand with silt	89.1	79.1
MW-ES-06	617517.59	1039200.03	173.30	46.0	56.0	SP-SM-sand +/- silt	127.3	117.3
MW-ES-07	617139.20	1037976.58	177.89	25.0	35.0	SP-sand SP-sand with gravel	152.9	142.9
MW-ES-08	617163.60	1037049.22	177.17	25.0	35.0	SP-SM-sand +/- silt	152.2	142.2
MW-ES-11	617586.81	1038492.29	166.28	80.0	90.0	SW, well graded sand	86.3	76.3
MW-96-15	617157.91	1038938.73	170.39	69.0	79.0	medium fine sand	101.4	91.4
MW-96-16	616836.42	1039704.25	181.00	50.5	60.5	fine medium sand	130.5	120.5
MW-96-17	616767.70	1039839.20	179.66	45.5	55.5	fine brown sand	134.2	124.2
Deschutes Valley Area								
MW-4A	617599.92	1040464.0	109.86	100	110	silty sand and gravel	9.9	-0.1
MW-4B	617599.9	1040464.0	109.85	80	90	silty sand	29.9	19.9
MW-ES-09	617754.43	1040021.9	108.33	20	30	SP-poorly graded sand with silty sand interbed	88.3	78.3
MW-ES-10	617761.34	1040013.1	108.25	82	92	unknown (no description)	26.3	16.3
MW-107	617052.39	1041164.92	114.66	25.0	35.0	ML-very hard, moist, gray silt SP-loose to medium dense, brown, medium to coarse sand	89.7	79.7
MW-110	618032.42	1041013.21	101.93	30.0	40.0	SP-loose to medium dense, gray, fine to medium sand	71.9	61.9
MW-93-02	617159.33	1040344.31	112.76	6.0	11.0	fine silty blue sand brown clay	106.8	101.8
PZ-704	618088.1	1039827.2	110.61	5	7.5	fine to coarse sand with cobbles and boulders	105.6	103.1
PZ-709	617880	1039819.2	114.27	5	7.5	fine to coarse sand with cobbles and boulders	109.3	106.8
PZ-715	617683.4	1039815.4	117.79	5	7.5	fine to coarse sand with cobbles and boulders	112.8	110.3
PZ-719	618200.7	1039999.7	107.13	7	10	fine to medium sand	100.1	97.1
PZ-720	618026.5	1039992.8	107.95	7	10	fine to medium sand	101.0	98.0
PZ-721	617873.9	1039991.1	108.32	7	10	fine to medium sand	101.3	98.3
PZ-722	617664.1	1039983.3	108.82	7	10	fine to medium sand	101.8	98.8
PZ-723	618244	1040200.4	106.45	7	10	fine to medium sand	99.5	96.5
PZ-724	617976.1	1040198.2	106.56	7	10	fine to medium sand	99.6	96.6
PZ-725	617741.3	1040220.1	108.31	7	10	fine to medium sand	101.3	98.3
PZ-726	618186	1040452.6	105.39	7	10	fine to medium sand	98.4	95.4
PZ-728	617851.61	1040464.0	105.33	7	10	fine to medium sand	98.3	95.3
RPZ-730	618243.76	1040685.0	103.897	4.13	9.13	log not on file	99.8	94.8
RPZ-731	617996.36	1040745.1	105.085	4.75	9.75	log not on file	100.3	95.3
RPZ-732	617731.13	1040684.1	105.687	4.63	9.63	log not on file	101.1	96.1
Palermo Wellfield								
TW-4	617494.23	1040658.29	105.14	60	90	large gravel and sand	45.1	15.1
TW-5[4]	617552.37	1040588.15	106.20	82	115	sand and gravel blue clay at 114 feet	24.2	-8.8
TW-8	617396.92	1040445.80	106.38	70	90	medium to coarse sand and gravel	36.4	16.4

Notes:

[1] Existing well locations and TOC elevations were obtained from previous explorations (Parametrix 2012, URS 1999 and personal communications with EPA 2013).

[2] Horizontal Datum: NAD83 WA State Plane North.

[3] Elevation in NAVD88 = North American Vertical Datum of 1988.

[4] Well abandoned or decommissioned.

bgs = below ground surface

TOC = Top of casing

Table 2

Groundwater Depths and Elevations

2014 Annual Groundwater Monitoring Report
Palermo Wellfield Superfund Site
Tumwater, Washington

Location	Top-of-Casing Elevation (feet NGVD)	Spring 2014		Summer 2014	
		Depth-to-Water (feet)	Water Level Elevation (feet NGVD)	Depth-to-Water (feet)	Water Level Elevation (feet NGVD)
Monitoring Wells					
MW-4A	109.86	5.37	104.49	8.37	101.49
MW-4B	109.85	5.26	104.59	8.26	101.59
MW-93-02	112.76	4.04	108.72	4.57	108.19
MW-96-15	165.608	25.02	140.59	26.81	138.80
MW-96-16	177.525	47.11	130.42	48.30	129.23
MW-96-17[1]	176.255	48.55	127.71	49.73	126.53
MW-100	177.70	16.08	161.62	18.50	159.20
MW-101A	176.25	19.08	157.17	21.21	155.04
MW-101B	176.19	18.77	157.42	21.00	155.19
MW-102	166.94	9.53	157.41	11.77	155.17
MW-103	163.74	5.86	157.88	8.11	155.63
MW-104A	170.64	51.99	118.65	53.12	117.52
MW-104B	170.51	49.39	121.12	50.59	119.92
MW-107	114.66	7.73	106.93	8.64	106.02
MW-109	168.89	18.93	149.96	21.00	147.89
MW-110	101.93	2.38	99.55	3.41	98.52
MW-111	165.41	25.29	140.12	27.22	138.19
MW-ES-02	174.65	52.65	122.00	53.88	120.77
MW-ES-03	175.07	47.79	127.28	49.03	126.04
MW-ES-04	175.11	48.17	126.94	49.32	125.79
MW-ES-05	175.05	42.90	132.15	44.32	130.73
MW-ES-06	173.30	43.38	129.92	44.74	128.56
MW-ES-07	177.89	19.43	158.46	21.73	156.16
MW-ES-09	108.33	-0.09	108.42	0.44	107.89
MW-ES-10	108.25	-2.09	110.34	-0.99	109.24
MW-ES-11	166.28	14.76	151.52	16.97	149.31
MW-UI	178.82	18.63	160.19	21.03	157.79
WDOT-MW-1	166.94	18.54	148.40	21.11	145.83
WDOT-MW-2	165.45	15.70	149.75	17.36	148.09
Piezometers					
PZ-704	110.61	4.44*	106.17	5.39*	105.22
PZ-709	114.27	2.75*	111.52	3.43*	110.84
PZ-715	117.79	4.00*	113.79	4.54*	113.25
PZ-719	107.13	2.06	105.07	2.68	104.45
PZ-720	107.95	2.87	105.08	4.05	103.90
PZ-721	108.32	2.65	105.67	3.22	105.10
PZ-722	108.82	-0.99	109.81	-0.62	109.44
PZ-723	106.45	2.33	104.12	2.74	103.71
PZ-724	106.56	9.13	97.43	1.82	104.74
PZ-725	108.31	2.42	105.89	2.85	105.46
PZ-726	105.39	2.77	102.62	3.23	102.16
PZ-728	105.33	2.15	103.18	2.70	102.63
RPZ-730	103.897	3.03	100.87	3.80	100.10
RPZ-731	105.085	4.06	101.03	4.87	100.22
RPZ-732	105.687	4.38	101.31	5.28	100.41
Production Wells					
TW-4	105.49	6.50	98.99	26.30	79.19
TW-8	106.48	4.30	102.18	30.60	75.88
TW-16	Not Measured	7.80	–	11.44	–
Barnes Lake	153.99**	Not Measured	–	1.57	155.56

Notes:

– = Not applicable

[1] Water level measured through top of hand pump.

*Depth to water measurement was taken from an above ground surface top of casing.

**Elevation of 0.00 Feet on the Barnes Lake staff gauge (NGVD 1929).

NGVD = National Geodetic Vertical Datum 1929

Groundwater depth-to-water measurements were collected from monitoring wells on April 14, 2014, and August 29, 2014.

Table 3

TCE and PCE Detected in Groundwater and Seep Samples

2014 Annual Groundwater Monitoring Report
Palermo Wellfield Superfund Site
Tumwater, Washington

	Analyte	Tetrachloroethene	Trichloroethene
	ROD Remediation Goal	5	5
Location ID	Date	(µg/L)	(µg/L)
MW-100	5/12/2004	0.5 U	0.5 U
MW-100	9/21/2004	1 U	0.5 U
MW-100	4/26/2005	0.5 U	0.5 U
MW-100	10/5/2005	0.5 U	0.5 U
MW-100	3/16/2006	1 U	1 U
MW-100	10/30/2006	1 U	1 U
MW-100	6/6/2007	1 U	1 U
MW-100	11/12/2007	1 U	1 U
MW-100	5/19/2008	0.5 U	0.5 U
MW-100	10/27/2008	1 U	1 U
MW-100	4/27/2009	0.5 U	0.5 U
MW-100	11/9/2009	0.5 U	0.5 U
MW-100	5/19/2010	0.5 U	0.5 U
MW-100	10/19/2010	0.5 U	0.5 U
MW-100	5/23/2011	0.5 U	0.5 U
MW-100	11/8/2011	0.5 U	0.5 U
MW-100	5/29/2012	0.5 U	0.5 U
MW-100	3/5/2013	1 U	1 U
MW-100	9/19/2013	0.5 U	0.5 U
MW-100	4/15/2014	0.20 U	0.20 U
MW-100	8/20/2014	0.20 UJ	0.20 UJ
MW-101A	3/17/2006	1 U	1 U
MW-101A	5/29/2012	0.5 U	0.5 U
MW-101A	3/6/2013	1 U	1 U
MW-101A	9/17/2013	0.5 U	0.5 U
MW-101A	4/15/2014	0.20 U	0.20 U
MW-101A	8/21/2014	0.20 UJ	0.20 UJ
MW-101B	3/17/2006	0.1 J	14
MW-101B	10/31/2006	1 U	6.2
MW-101B	6/6/2007	1 U	5.5
MW-101B	11/13/2007	1 U	5.7
MW-101B	5/20/2008	0.5 U	6.2
MW-101B	10/28/2008	1 U	3.9
MW-101B	4/28/2009	0.5 U	17
MW-101B	11/10/2009	0.5 U	2.2
MW-101B	5/19/2010	0.5 U	3.6
MW-101B	10/21/2010	0.5 U	3.3
MW-101B	5/24/2011	0.5 U	2.2
MW-101B	11/8/2011	0.5 U	3.7
MW-101B	5/29/2012	0.5 U	2.7
MW-101B	3/5/2013	1 U	3
MW-101B	9/17/2013	0.5 U	3.3
MW-101B	4/15/2014	0.20 U	2.9
MW-101B	8/21/2014	0.20 UJ	2.7 J
MW-102	6/4/2012	0.5 U	0.5 U
MW-102	3/5/2013	1 U	1 U
MW-102	9/17/2013	0.5 U	0.5 U
MW-102	4/17/2014	0.20 U	0.20 U
MW-102	8/22/2014	0.20 UJ	0.20 UJ
MW-103	6/4/2012	0.5 U	0.5 U
MW-103	3/6/2013	1 U	1 U
MW-103	9/18/2013	0.5 U	0.5 U
MW-103	4/16/2014	0.20 U	0.20 U
MW-103	8/22/2014	0.20 UJ	0.20 UJ
MW-104A	3/17/2006	1 U	6.6
MW-104A	10/31/2006	1 U	11
MW-104A	6/4/2012	0.5 U	5.3
MW-104A	3/7/2013	1 U	8
MW-104A	9/27/2013	0.5 U	4.6
MW-104A	4/18/2014	0.20 U	3.9
MW-104A	8/28/2014	0.20 U	4.5
MW-104B	5/11/2004	1.9	0.26 J
MW-104B	9/21/2004	1.6	0.5 U
MW-104B	4/26/2005	0.97	0.5 U
MW-104B	10/6/2005	0.09	0.5 U
MW-104B	3/16/2006	1.5	1 U
MW-104B	10/31/2006	1.7	1 U
MW-104B	6/7/2007	1.9	1 U
MW-104B	11/13/2007	2.4	1 U
MW-104B	5/20/2008	1.3	0.5 U
MW-104B	10/28/2008	1.6	1 U
MW-104B	4/29/2009	5 U	5 U
MW-104B	11/11/2009	0.87	0.5 U
MW-104B	5/20/2010	1.4	0.057 J
MW-104B	10/22/2010	1.8	0.5 U
MW-104B	5/26/2011	0.95	0.5 U
MW-104B	11/9/2011	1.6	0.5 U
MW-104B	6/4/2012	1.3	0.5 U
MW-104B	3/11/2013	1.4	1 U
MW-104B	9/27/2013	1.5	0.5 U

	Analyte	Tetrachloroethene	Trichloroethene
	ROD Remediation Goal	5	5
Location ID	Date	(µg/L)	(µg/L)
MW-ES-07	5/19/2010	0.5 U	4.8
MW-ES-07	10/21/2010	0.5 U	5.1
MW-ES-07	5/24/2011	0.5 U	4.5
MW-ES-07	11/8/2011	0.5 U	9.7
MW-ES-07	5/29/2012	0.5 U	4.4
MW-ES-07	3/5/2013	1 U	3.9
MW-ES-07	9/17/2013	0.5 U	7
MW-ES-07	4/15/2014	0.20 U	4.3
MW-ES-07	8/20/2014	0.20 UJ	4.2 J
MW-ES-08	5/29/2012	0.5 U	0.5 U
MW-ES-08	3/5/2013	1 U	1 U
MW-ES-08	9/19/2013	0.5 U	0.5 U
MW-ES-09	5/11/2004	0.5 U	220
MW-ES-09	9/22/2004	1 U	200
MW-ES-09	4/27/2005	0.5 U	300
MW-ES-09	10/6/2005	0.5 U	120
MW-ES-09	3/22/2006	1 U	176
MW-ES-09	11/2/2006	1 U	170
MW-ES-09	6/8/2007	1 U	169
MW-ES-09	11/14/2007	1 U	160
MW-ES-09	5/21/2008	0.5 U	150
MW-ES-09	10/29/2008	1 U	150
MW-ES-09	4/30/2009	5 U	140
MW-ES-09	11/11/2009	0.5 U	73
MW-ES-09	5/21/2010	0.5 U	150
MW-ES-09	10/22/2010	0.5 U	130
MW-ES-09	5/26/2011	0.5 U	120
MW-ES-09	11/9/2011	0.5 U	150
MW-ES-09	6/5/2012	0.5 U	150 J
MW-ES-09	3/11/2013	1 U	120
MW-ES-09	9/26/2013	1 U	120
MW-ES-09	4/21/2014	1.0 U	110
MW-ES-09	8/28/2014	0.40 U	100
MW-ES-10	5/11/2004	0.5 U	83
MW-ES-10	9/22/2004	1 U	83
MW-ES-10	4/27/2005	0.5 U	78
MW-ES-10	10/6/2005	0.5 U	75
MW-ES-10	3/22/2006	1 U	65
MW-ES-10	11/2/2006	1 U	68
MW-ES-10	6/8/2007	1 U	63
MW-ES-10	11/14/2007	1 U	61
MW-ES-10	5/21/2008	0.5 U	46
MW-ES-10	10/29/2008	1 U	52
MW-ES-10	4/30/2009	5 U	34
MW-ES-10	11/11/2009	0.5 U	29
MW-ES-10	5/21/2010	0.5 U	53
MW-ES-10	10/22/2010	0.5 U	52
MW-ES-10	5/26/2011	0.5 U	36
MW-ES-10	11/9/2011	0.5 U	53
MW-ES-10	6/5/2012	0.5 U	67 J
MW-ES-10	3/11/2013	1 U	37
MW-ES-10	9/26/2013	0.5 U	36
MW-ES-10	4/22/2014	0.20 U	35
MW-ES-10	8/28/2014	0.20 U	32
MW-ES-11	5/31/2012	0.5 U	0.5 U
MW-ES-11	3/6/2013	1 U	1 U
MW-ES-11	9/17/2013	0.5 U	0.5 U
MW-ES-11	4/17/2014	0.20 U	0.22
MW-ES-11	8/25/2014	0.20 UJ	0.30 J
MW-UI	5/12/2004	0.5 U	21 J
MW-UI	9/21/2004	1 U	17
MW-UI	4/26/2005	0.5 U	8.8
MW-UI	10/5/2005	0.5 U	3.6
MW-UI	3/17/2006	1 U	5.2
MW-UI	10/31/2006	1 U	12
MW-UI	6/6/2007	1 U	23
MW-UI	11/12/2007	1 U	28
MW-UI	5/19/2008	0.5 U	16
MW-UI	10/28/2008	1 U	8.3
MW-UI	4/27/2009	0.5 U	7.9
MW-UI	11/10/2009	0.5 U	3.8
MW-UI	5/19/2010	0.5 U	7.8
MW-UI	10/19/2010	0.5 U	8.1
MW-UI	5/24/2011	0.5 U	11
MW-UI	11/8/2011	0.5 U	11
MW-UI	5/29/2012	0.5 U	9.3
MW-UI	3/5/2013	1 U	8.1
MW-UI	9/19/2013	0.5 U	6.6
MW-UI	4/15/2014	0.20 U	7.9
MW-UI	8/20/2014	0.20 UJ	7.3 J

Analyte		Tetrachloroethene	Trichloroethene
ROD Remediation Goal		5	5
Location ID	Date	(µg/L)	(µg/L)
MW-104B	4/18/2014	0.99	0.20 U
MW-104B	8/28/2014	1.0	0.20 U
MW-107	6/7/2012	0.5 U	0.5 U
MW-107	3/6/2013	1 U	1 U
MW-107	9/20/2013	0.5 U	0.5 U
MW-107	4/18/2014	0.20 U	0.20 U
MW-107	8/27/2014	0.20 U	0.20 U
MW-109	5/12/2004	0.5 U	31
MW-109	9/21/2004	1 U	32
MW-109	4/26/2005	0.5 U	15
MW-109	10/5/2005	0.5 U	22
MW-109	3/20/2006	1 U	27
MW-109	11/1/2006	1 U	25
MW-109	6/7/2007	1 U	22
MW-109	11/13/2007	1 U	22
MW-109	5/20/2008	0.5 U	10
MW-109	10/28/2008	1 U	20
MW-109	4/28/2009	0.5 U	17
MW-109	11/10/2009	0.5 U	8.3
MW-109	5/19/2010	0.5 U	16
MW-109	10/21/2010	0.5 U	17
MW-109	5/24/2011	0.5 U	13
MW-109	11/8/2011	0.5 U	19
MW-109	5/30/2012	0.5 U	13
MW-109	3/5/2013	1 U	15
MW-109	9/18/2013	0.5 U	16
MW-109	4/16/2014	0.20 U	15
MW-109	8/21/2014	0.20 UJ	14 J
MW-110	5/12/2004	0.5 U	0.5 U
MW-110	9/21/2004	1 U	0.5 U
MW-110	4/26/2005	0.5 U	0.5 U
MW-110	10/5/2005	0.5 U	0.5 U
MW-110	3/15/2006	1 U	1U
MW-110	10/31/2006	1 U	1 U
MW-110	6/6/2007	1 U	1 U
MW-110	11/12/2007	1 U	1 U
MW-110	5/20/2008	0.5 U	0.5 U
MW-110	10/28/2008	1 U	1 U
MW-110	4/28/2009	0.5 U	0.5 U
MW-110	11/10/2009	0.5 U	0.5 U
MW-110	5/19/2010	0.5 U	0.5 U
MW-110	10/20/2010	0.5 U	0.5 U
MW-110	5/24/2011	0.5 U	0.5 U
MW-110	11/8/2011	0.5 U	0.5 U
MW-110	6/7/2012	0.5 U	0.5 U
MW-110	3/6/2013	1 U	1 U
MW-110	9/20/2013	0.5 U	0.5 U
MW-110	4/18/2014	0.20 U	0.20 U
MW-110	8/27/2014	0.20 U	0.20 U
MW-111	5/12/2004	0.5 U	22
MW-111	9/21/2004	1 U	17
MW-111	4/26/2005	0.5 U	0.5 U
MW-111	10/5/2005	0.5 U	12
MW-111	3/17/2006	1 U	20
MW-111	11/1/2006	1 U	16
MW-111	6/6/2007	1 U	18
MW-111	11/13/2007	1 U	16
MW-111	5/20/2008	0.5 U	14
MW-111	10/28/2008	1 U	17
MW-111	4/28/2009	0.5 U	11
MW-111	11/10/2009	0.5 U	5.8
MW-111	5/19/2010	0.5 U	12
MW-111	10/21/2010	0.5 U	11
MW-111	5/24/2011	0.5 U	12
MW-111	11/8/2011	0.5 U	13
MW-111	5/30/2012	0.5 U	12
MW-111	3/7/2013	1 U	9.1
MW-111	9/19/2013	0.5 U	9.2
MW-111	4/16/2014	0.20 U	8.4
MW-111	8/22/2014	0.20 UJ	7.7 J
MW-4A	3/20/2006	1 U	1 U
MW-4A	6/5/2012	0.5 U	0.5 U
MW-4A	3/12/2013	1 U	1 U
MW-4A	9/26/2013	0.5 U	0.5 U
MW-4A	4/22/2014	0.20 U	0.20 U
MW-4A	8/28/2014	0.20 U	0.20 U
MW-4B	3/20/2006	1 U	1 U
MW-4B	6/5/2012	0.5 U	0.5 U
MW-4B	3/12/2013	1 U	1 U
MW-4B	9/26/2013	0.5 U	0.5 U
MW-4B	4/22/2014	0.20 U	0.20 U
MW-4B	8/28/2014	0.20 U	0.20 U
MW-93-02	6/5/2012	0.5 U	0.5 U
MW-93-02	3/12/2013	1 U	1 U
MW-93-02	9/20/2013	0.5 U	0.5 U
MW-93-02	4/17/2014	0.20 U	0.20 U
MW-93-02	8/28/2014	0.20 U	0.20 U

Analyte		Tetrachloroethene	Trichloroethene
ROD Remediation Goal		5	5
Location ID	Date	(µg/L)	(µg/L)
PZ-704	6/6/2012	0.5 U	0.5 U
PZ-704	3/13/2013	1 U	1 U
PZ-704	9/23/2013	0.5 U	0.5 U
PZ-704	4/21/2014	0.20 U	0.20 U
PZ-709	6/6/2012	0.5 U	0.5 U
PZ-709	3/13/2013	1 U	1 U
PZ-709	9/23/2013	0.2 UJ	0.2 UJ
PZ-709	4/21/2014	0.20 U	0.20 U
PZ-715	6/6/2012	0.5 U	0.5 U
PZ-715	3/13/2013	1 U	1 U
PZ-715	9/23/2013	0.5 U	0.5 U
PZ-715	4/21/2014	0.20 U	0.20 U
PZ-719	6/6/2012	0.5 U	1.7
PZ-719	3/14/2013	1 U	1.6
PZ-719	9/24/2013	0.5 U	2.1
PZ-719	1/28/2014	0.20 U	2.0
PZ-719	4/18/2014	0.20 U	1.8
PZ-719	8/18/2014	0.20 UJ	1.5 J
PZ-720	2/1/2004	1.1	17
PZ-720	6/6/2012	0.5 U	6.6 J
PZ-720	3/14/2013	0.38 J	5
PZ-720	9/24/2013	0.55	9.7
PZ-720	1/29/2014	0.51	6.7
PZ-720	4/18/2014	0.40	5.5
PZ-720	8/19/2014	0.94	16
PZ-721	2/1/2004	0.79	98
PZ-721	3/15/2006	0.4 J	47
PZ-721	11/2/2006	0.69 J	59
PZ-721	6/5/2007	1 U	35
PZ-721	11/14/2007	0.53 J	52
PZ-721	5/21/2008	0.39 J	41
PZ-721	10/27/2008	1 U	19
PZ-721	4/30/2009	5 U	35
PZ-721	11/11/2009	0.5 U	27
PZ-721	5/19/2010	0.2 J	41
PZ-721	10/20/2010	0.5 U	48
PZ-721	5/26/2011	0.5 U	30
PZ-721	11/10/2011	0.5 U	44
PZ-721	6/6/2012	0.5 U	38
PZ-721	3/14/2013	1 U	30
PZ-721	9/24/2013	0.5 U	54
PZ-721	1/29/2014	0.20 U	34
PZ-721	4/22/2014	0.20 U	37
PZ-721	8/19/2014	0.40 U	61
PZ-722	6/6/2012	0.5 U	0.5 U
PZ-722	3/14/2013	1 U	1 U
PZ-722	9/25/2013	0.5 U	0.5 U
PZ-722	1/29/2014	0.20 U	0.20 U
PZ-722	4/22/2014	0.20 U	0.20 U
PZ-722	8/19/2014	0.20 U	0.20 U
PZ-723	6/6/2012	0.5 U	0.5 U
PZ-723	3/14/2013	1 U	1 U
PZ-723	9/25/2013	0.5 U	0.5 U
PZ-723	1/28/2014	0.20 U	0.20 U
PZ-723	4/23/2014	0.20 U	0.20 U
PZ-723	8/18/2014	0.20 UJ	0.20 UJ
PZ-724	2/1/2004	0.45 J	39
PZ-724	3/15/2006	0.3 J	28
PZ-724	11/2/2006	1 U	37
PZ-724	6/5/2007	1 U	15
PZ-724	11/14/2007	1 U	32
PZ-724	5/21/2008	0.22 J	87
PZ-724	10/27/2008	1 U	44
PZ-724	4/30/2009	5 U	35
PZ-724	11/11/2009	0.5 U	28
PZ-724	5/19/2010	0.5 U	34
PZ-724	10/20/2010	0.5 U	43
PZ-724	5/26/2011	0.5 U	30
PZ-724	11/10/2011	0.5 U	53
PZ-724	6/7/2012	0.5 U	13
PZ-724	3/14/2013	1 U	32
PZ-724	9/25/2013	0.5 U	43
PZ-724	1/29/2014	0.20 U	40
PZ-724	4/22/2014	0.20 U	29
PZ-724	8/19/2014	0.20 U	41
PZ-725	2/1/2004	0.5 U	0.35 J
PZ-725	6/8/2012	0.5 U	0.5 U
PZ-725	3/14/2013	1 U	1 U
PZ-725	9/24/2013	0.5 U	0.5 U
PZ-725	1/29/2014	0.20 U	0.20 U
PZ-725	4/22/2014	0.20 U	0.20 U
PZ-725	8/19/2014	0.20 U	0.20 U
PZ-726	2/1/2004	0.5 U	3.1
PZ-726	6/8/2012	0.5 U	3.4 J
PZ-726	3/12/2013	1 U	2.7
PZ-726	9/25/2013	0.5 U	3.8
PZ-726	1/28/2014	0.20 U	3.2

Location ID	Date	Tetrachloroethene	Trichloroethene
	ROD Remediation Goal	5	5
		(µg/L)	(µg/L)
MW-96-15	5/30/2012	0.5 U	0.5 U
MW-96-15	3/7/2013	1 U	1 U
MW-96-15	9/17/2013	0.5 U	0.5 U
MW-96-15	4/17/2014	0.20 U	0.20 U
MW-96-15	8/26/2014	0.20 U	0.20 U
MW-96-16	6/5/2012	0.5 U	0.5 U
MW-96-16	3/6/2013	1 U	1 U
MW-96-16	9/18/2013	0.5 U	0.5 U
MW-96-16	4/16/2014	0.20 U	0.20 U
MW-96-16	8/26/2014	0.20 U	0.20 U
MW-96-17	6/5/2012	0.5 U	0.5 U
MW-96-17	3/6/2013	1 U	1 U
MW-96-17	9/18/2013	0.5 U	0.5 U
MW-96-17	4/15/2014	0.20 U	0.20 U
MW-96-17	8/26/2014	0.20 U	0.20 U
MW-ES-02	3/22/2006	1 U	56
MW-ES-02	11/1/2006	1 U	68
MW-ES-02	6/7/2007	1 U	66
MW-ES-02	11/14/2007	1 U	66
MW-ES-02	5/20/2008	0.5 U	47
MW-ES-02	10/29/2008	1 U	50
MW-ES-02	4/29/2009	5 U	43
MW-ES-02	11/11/2009	0.5 U	29
MW-ES-02	5/20/2010	0.5 U	53
MW-ES-02	10/22/2010	0.5 U	58
MW-ES-02	5/26/2011	0.5 U	46
MW-ES-02	11/8/2011	0.5 U	51
MW-ES-02	5/31/2012	0.5 U	47
MW-ES-02	3/7/2013	1 U	38
MW-ES-02	9/20/2013	0.5 U	39
MW-ES-02	4/21/2014	0.20 U	39
MW-ES-02	8/27/2014	0.20 U	34
MW-ES-03	5/11/2004	0.5 U	37
MW-ES-03	9/22/2004	1 U	42
MW-ES-03	4/27/2005	0.5 U	22
MW-ES-03	10/6/2005	0.13 J	22
MW-ES-03	3/20/2006	1 U	27
MW-ES-03	11/1/2006	1 U	22
MW-ES-03	6/7/2007	1 U	26
MW-ES-03	11/14/2007	1 U	26
MW-ES-03	5/21/2008	0.5 U	24
MW-ES-03	10/29/2008	1 U	25
MW-ES-03	4/29/2009	5 U	16
MW-ES-03	11/12/2009	0.5 U	12
MW-ES-03	5/20/2010	0.5 U	21
MW-ES-03	10/21/2010	0.5 U	25
MW-ES-03	5/25/2011	0.5 U	21
MW-ES-03	11/9/2011	0.5 U	27
MW-ES-03	6/4/2012	0.5 U	21
MW-ES-03	3/7/2013	1 U	17
MW-ES-03	9/19/2013	0.5 U	18
MW-ES-03	4/17/2014	0.20 U	16
MW-ES-03	8/27/2014	0.20 U	14
MW-ES-04	5/11/2004	58	0.52
MW-ES-04	9/22/2004	52	0.44 J
MW-ES-04	4/27/2005	51	0.35 J
MW-ES-04	10/6/2005	38	0.24 J
MW-ES-04	3/20/2006	48	0.8 J
MW-ES-04	11/1/2006	43	1.2
MW-ES-04	6/7/2007	35	1.2
MW-ES-04	11/14/2007	38	1.7
MW-ES-04	5/21/2008	49	1.8
MW-ES-04	10/29/2008	25	1.1
MW-ES-04	4/29/2009	21	0.56 J
MW-ES-04	11/12/2009	16	0.38 J
MW-ES-04	5/20/2010	42	0.64 J
MW-ES-04	10/21/2010	34	0.6
MW-ES-04	5/25/2011	23	0.52
MW-ES-04	11/9/2011	26	0.75
MW-ES-04	6/4/2012	31	0.82
MW-ES-04	3/8/2013	44	0.56 J
MW-ES-04	9/19/2013	32	0.5 U
MW-ES-04	4/17/2014	34	0.31
MW-ES-04	8/27/2014	16	0.20 U
MW-ES-05	5/11/2004	0.5 U	46 J
MW-ES-05	9/22/2004	1 U	44
MW-ES-05	4/26/2005	0.5 U	52
MW-ES-05	10/5/2005	0.5 U	37
MW-ES-05	3/21/2006	1 U	46
MW-ES-05	11/1/2006	1 U	58
MW-ES-05	6/7/2007	1 U	54
MW-ES-05	11/13/2007	1 U	53
MW-ES-05	5/21/2008	0.21 J	58
MW-ES-05	10/29/2008	1 U	41
MW-ES-05	4/29/2009	5 U	27
MW-ES-05	11/11/2009	0.5 U	16
MW-ES-05	5/20/2010	0.5 U	33
MW-ES-05	10/22/2010	0.5 U	36
MW-ES-05	5/25/2011	0.5 U	30
MW-ES-05	11/9/2011	0.5 U	35
MW-ES-05	5/30/2012	0.5 U	32

Location ID	Date	Tetrachloroethene	Trichloroethene
	ROD Remediation Goal	5	5
		(µg/L)	(µg/L)
PZ-726	4/23/2014	0.20 U	3.1
PZ-726	8/18/2014	0.20 UJ	3.6 J
PZ-728	2/1/2004	0.5 U	31
PZ-728	3/15/2006	1 U	24
PZ-728	11/2/2006	1 U	16
PZ-728	6/5/2007	1 U	18
PZ-728	11/14/2007	1 U	21
PZ-728	5/21/2008	0.5 U	14
PZ-728	10/27/2008	1 U	51
PZ-728	4/30/2009	5 U	9.1
PZ-728	11/11/2009	0.5 U	8.2
PZ-728	5/19/2010	0.5 U	10
PZ-728	10/20/2010	0.5 U	12
PZ-728	5/26/2011	0.5 U	6
PZ-728	11/10/2011	0.5 U	7.7
PZ-728	6/8/2012	0.5 U	4.5 J
PZ-728	3/7/2013	1 U	4.7
PZ-728	9/25/2013	0.5 U	5.1
PZ-728	1/29/2014	0.20 U	4.2
PZ-728	4/23/2014	0.20 U	4.2
PZ-728	8/18/2014	0.20 UJ	4.0 J
RPZ-730	6/4/2012	0.5 U	0.5 U
RPZ-730	3/13/2013	1 U	1 U
RPZ-730	9/24/2013	0.5 U	0.5 U
RPZ-730	1/28/2014	0.20 U	0.20 U
RPZ-730	4/23/2014	0.20 U	0.20 U
RPZ-730	8/18/2014	0.20 UJ	0.20 UJ
RPZ-731	6/4/2012	0.5 U	0.61
RPZ-731	3/13/2013	1 U	0.6 J
RPZ-731	9/24/2013	0.5 U	1.6
RPZ-731	1/29/2014	0.20 U	0.64
RPZ-731	4/23/2014	0.20 U	0.65
RPZ-731	8/19/2014	0.20 U	1.6
RPZ-732	6/5/2012	0.5 U	0.5 U
RPZ-732	3/12/2013	1 U	1 U
RPZ-732	9/24/2013	0.5 U	0.5 U
RPZ-732	1/29/2014	0.20 U	0.20 U
RPZ-732	4/22/2014	0.23	0.20 U
RPZ-732	8/19/2014	0.29	0.20 U
Seep 1	5/30/2012	0.5 U	0.5 U
Seep 1	3/19/2013	1 U	1 U
Seep 1	10/2/2013	0.5 U	0.5 U
Seep 1	4/21/2014	0.20 U	0.20 U
Seep 2	5/30/2012	0.5 U	0.5 U
Seep 2	3/19/2013	1 U	1 U
Seep 2	10/2/2013	0.5 U	0.5 U
Seep 2	4/21/2014	0.20 U	0.20 U
Seep 3	5/31/2012	0.5 U	0.5 U
Seep 3	3/19/2013	1 U	1 U
Seep 3	10/2/2013	0.5 U	0.5 U
Seep 3	4/21/2014	0.20 U	0.20 U
Seep 5	5/31/2012	0.5 U	0.5 U
Seep 5	5/31/2012	0.5 U	0.5 U
Seep 5	3/19/2013	1 U	1 U
Seep 5	10/2/2013	0.5 U	0.5 U
Seep 5	4/21/2014	0.20 U	0.20 U
ST-1	6/5/2007	1.0 U	1.0 U
ST-1	11/14/2007	1.0 U	1.0 U
ST-1	5/21/2008	0.5 U	0.5 U
ST-1	10/29/2008	1.0 U	1.0 U
ST-1	5/23/2011	0.5 U	0.5 U
ST-1	11/7/2011	0.5 U	0.5 U
ST-1	4/18/2014	0.20 U	0.20 U
ST-1	8/25/2014	0.20 U	0.20 U
ST-2	6/5/2007	1.0 U	1.0 U
ST-2	11/14/2007	1.0 U	1.0 U
ST-2	5/21/2008	0.5 U	0.5 U
ST-2	4/29/2009	0.5 U	0.5 U
ST-2	11/10/2009	0.5 U	0.5 U
ST-2	5/18/2010	0.5 U	0.5 U
ST-2	10/20/2010	0.5 U	0.5 U
ST-2	6/11/2012	0.5 U	0.5 U
ST-2	3/7/2013	1.0 U	1.0 U
ST-2	9/18/2013	0.5 U	0.5 U
TW-4	3/15/2006	1.0 U	3.4
TW-4	11/2/2006	1.0 U	2.1
TW-4	6/4/2007	1.0 U	3.3
TW-4	11/14/2007	1.0 U	2.2
TW-4	5/21/2008	0.5 U	0.61
TW-4	10/29/2008	1.0 U	1.3
TW-4	4/30/2009	0.5 U	1.3
TW-4	11/10/2009	0.5 U	0.85
TW-4	5/18/2010	0.5 U	1.1
TW-4	10/20/2010	0.5 U	0.76
TW-4	5/23/2011	0.5 U	0.5 U
TW-4	11/7/2011	0.5 U	0.5 U
TW-4	6/11/2012	0.5 U	0.71 J
TW-4	3/7/2013	1.0 U	1.7
TW-4	9/18/2013	0.5 U	1.3
TW-4	4/18/2014	0.20 U	0.43
TW-4	8/25/2014	0.20 U	0.89

	Analyte	Tetrachloroethene	Trichloroethene
	ROD Remediation Goal	5	5
Location ID	Date	(µg/L)	(µg/L)
MW-ES-05	3/8/2013	1 U	**27**
MW-ES-05	9/20/2013	0.5 U	**27**
MW-ES-05	4/21/2014	0.20 U	**25**
MW-ES-05	8/27/2014	0.20 U	**24**
MW-ES-06	5/11/2004	**31**	**11**
MW-ES-06	9/22/2004	**26**	**11**
MW-ES-06	4/26/2005	**15**	**4.6**
MW-ES-06	10/5/2005	**19**	**11**
MW-ES-06	3/21/2006	**25**	**16**
MW-ES-06	11/1/2006	**34**	**12**
MW-ES-06	6/7/2007	**49**	**6.1**
MW-ES-06	11/13/2007	**40**	**6.9**
MW-ES-06	5/21/2008	**16**	**4.7**
MW-ES-06	10/29/2008	**18**	**5.7**
MW-ES-06	4/29/2009	**16**	5 U
MW-ES-06	11/11/2009	**11**	**2.3**
MW-ES-06	5/20/2010	**18**	**3.1**
MW-ES-06	10/22/2010	**14**	**2.7**
MW-ES-06	5/25/2011	**26**	**1.2**
MW-ES-06	11/9/2011	**36**	**1.6**
MW-ES-06	5/30/2012	**34**	**1.2**
MW-ES-06	3/8/2013	**23**	**0.97 J**
MW-ES-06	9/20/2013	**27**	**0.76**
MW-ES-06	4/21/2014	**13**	**1.1**
MW-ES-06	8/28/2014	**15**	**0.71**
MW-ES-07	3/20/2006	**0.1 J**	**7.8**
MW-ES-07	10/31/2006	1 U	**11**
MW-ES-07	6/6/2007	1 U	**10**
MW-ES-07	11/13/2007	1 U	**11**
MW-ES-07	5/20/2008	0.5 U	**8.6**
MW-ES-07	10/28/2008	1 U	**6.9**
MW-ES-07	4/28/2009	0.5 U	**4.7**
MW-ES-07	11/10/2009	0.5 U	**3.6**

	Analyte	Tetrachloroethene	Trichloroethene
	ROD Remediation Goal	5	5
Location ID	Date	(µg/L)	(µg/L)
TW-5	3/15/2006	1.0 U	**7.4**
TW-5	11/2/2006	1.0 U	**6.5**
TW-5	6/5/2007	1.0 U	**10**
TW-5	11/14/2007	1.0 U	**8.4**
TW-5	5/21/2008	0.5 U	**3.8**
TW-5	10/29/2008	1.0 U	**3.7**
TW-5	4/29/2009	0.5 U	**2.5**
TW-5	11/10/2009	0.5 U	**1.1**
TW-5	5/18/2010	0.5 U	**1.2**
TW-5	10/20/2010	0.5 U	0.5 U
TW-5	5/23/2011	0.5 U	0.5 U
TW-5	11/7/2011	0.5 U	0.5 U
TW-5	6/11/2012	0.5 U	0.5 U
TW-5	3/7/2013	1.0 U	1.0 U
TW-5	9/18/2013	0.5 U	0.5 U
TW-8	6/11/2012	0.5 U	0.5 U
TW-8	3/7/2013	1.0 U	1.0 U
TW-8	9/18/2013	0.5 U	0.5 U
TW-8	4/18/2014	0.20 U	0.20 U
TW-8	8/25/2014	0.20 U	0.20 U
TW-16	4/18/2014	0.20 U	**9.6**
TW-16	8/27/2014	0.20 U	**19**
WDOT-MW-1	5/31/2012	0.5 U	0.5 U
WDOT-MW-1	3/7/2013	1 U	1 U
WDOT-MW-1	9/18/2013	0.5 U	0.5 U
WDOT-MW-1	4/16/2014	0.20 U	0.20 U
WDOT-MW-1	8/25/2014	0.20 UJ	0.20 UJ
WDOT-MW-2	5/31/2012	0.5 U	0.5 U
WDOT-MW-2	3/6/2013	1 U	1 U
WDOT-MW-2	9/18/2013	0.5 U	0.5 U
WDOT-MW-2	4/16/2014	0.20 U	0.20 U
WDOT-MW-2	8/25/2014	0.20 UJ	0.20 UJ

Notes:

µg/L = microgram per liter

J = detected above the method detection limit but below the reporting limit

U = not detected at or above the reporting limit

Bold font type indicates the analyte was detected above the reporting limit.

Gray shading indicates the analyte was detected above the ROD Remediation Goal.

Samples were also analyzed for 1,1-DCE, trans-1,2-DCE, cis-1,2-DCE and vinyl chloride.

Table 4

Mann-Kendall Statistical Trends
2014 Annual Groundwater Monitoring Report
Palermo Wellfield Superfund Site
Tumwater, Washington

Location ID	Total Number of VOC Samples Collected*	PCE Maximum Concentration Detected* (µg/L)/Date	General Long Term PCE Concentration Statistical Trend (95 Percent Confidence Limit)	TCE Maximum Concentration Detected* (µg/L)/ Date	General Long Term TCE Concentration Statistical Trend (95 Percent Confidence Limit)
MW-101B	17	0.1 / Mar 2006	No Statistically Significant Trend	17 / Apr 2009	Decreasing
MW-104A	7	1.7 / Oct 2006	Decreasing	8 / Mar 2013	No Statistically Significant Trend
MW-104B	21	2.4 / Nov 2007	No Statistically Significant Trend	11 / Oct 2006	No Statistically Significant Trend
MW-109	21	ND	Not Detected	32 / Sep 2004	Decreasing
MW-110	21	ND	Not Detected	ND	No Statistically Significant Trend
MW-111	21	ND	Not Detected	22 / May 2004	Decreasing
MW-UI	21	ND	Not Detected	28 / Nov 2007	Decreasing
MW-ES-02	17	ND	Not Detected	68 / Nov 2006	Decreasing
MW-ES-03	21	1.4 / Oct 2005	Decreasing	42 / Sep 2004	Decreasing
MW-ES-04	21	58 / May 2004	Decreasing	1.8 / May 2008	No Statistically Significant Trend
MW-ES-05	21	0.21 / May 2008	No Statistically Significant Trend	58 / Nov 2006	Decreasing
MW-ES-06	21	49 / Jun 2007	No Statistically Significant Trend	16 / Mar 2006	Decreasing
MW-ES-07	17	0.1 / Mar 2006	No Statistically Significant Trend	11 / Nov 2007	Decreasing
MW-ES-09	21	ND	Not Detected	300 / Apr 2005	Decreasing
MW-ES-10	21	ND	Not Detected	83 / Sep 2004	Decreasing
PZ-719	6	ND	Not Detected	2.1 / Sep 2013	No Statistically Significant Trend
PZ-720	7	1.1 / Feb 2004	No Statistically Significant Trend	17 / Feb 2004	No Statistically Significant Trend
PZ-721	18	0.79 / Feb 2004	Decreasing	98 / Feb 2004	No Statistically Significant Trend
PZ-724	18	0.45 / Feb 2004	No Statistically Significant Trend	87 / May 2008	No Statistically Significant Trend
PZ-725	7	ND	Not Detected	0.35 / Feb 2004	No Statistically Significant Trend
PZ-726	8	ND	Not Detected	24 / Mar 2006	No Statistically Significant Trend
PZ-728	17	ND	Not Detected	51 / Oct 2008	Decreasing
RPZ-731	6	ND	Not Detected	1.6 / Mar 2006	No Statistically Significant Trend
TW-4	17	ND	Not Detected	3.4 / Mar 2006	Decreasing

Notes:

*Since long term monitoring began in 2004.

ND = Compound not detected.

Table 5

Neighborhood Piezometer Elevations

2014 Annual Groundwater Monitoring Report
Palermo Wellfield Superfund Site
Tumwater, Washington

Location	Top-of-Casing Elevation (feet NGVD) [1]	Ground Surface Elevation (feet NGVD) [1]	Spring 2014		Summer 2014	
			Depth to Water April 14, 2014 (feet BTOC)	Groundwater Elevation (feet NGVD)	Depth to Water August 29, 2014 (feet BTOC)	Groundwater Elevation (feet NGVD)
Bluff and Rainier Avenue Piezometers						
PZ-704	110.61	108.43	4.44*	106.17	5.39*	105.22
PZ-709	114.27	112.01	2.75*	111.52	3.43*	110.84
PZ-715	117.79	115.51	4.00*	113.79	4.54*	113.25
PZ-720	107.95	108.22	2.87	105.08	4.05	103.90
PZ-721	108.32	108.57	2.65	105.67	3.22	105.10
PZ-722	108.82	109.21	-0.99	109.81	-0.62	109.44
Other Neighborhood Piezometers						
PZ-719	107.13	107.37	2.06	105.07	2.68	104.45
PZ-723	106.45	106.80	2.33	104.12	2.74	103.71
PZ-724	106.56	106.88	9.13	97.43	1.82	104.74
PZ-725	108.31	108.58	2.42	105.89	2.85	105.46
PZ-726	105.39	105.61	2.77	102.62	3.23	102.16
PZ-728	105.33	105.84	2.15	103.18	2.70	102.63
RPZ-730	103.897	**	3.03	100.87	3.80	100.10
RPZ-731	105.085	**	4.06	101.03	4.87	100.22
RPZ-732	105.687	**	4.38	101.31	5.28	100.41

Notes:

BTOC = Below top of casing

[1]Elevations surveyed by White Shield for URS, January 5, 2000, Vertical Datum: NGVD 29

*Depth to water measurement was taken from an above ground surface top of casing.

**Ground surface not surveyed

NGVD = National Geodetic Vertical Datum 1929

Table 6A

Spring 2014 Discharge Volume and Analytical Results - Subdrain and Lagoon

2014 Annual Groundwater Monitoring Report

Palermo Wellfield Superfund Site

Tumwater, Washington

Location	Station Description	Volume (GPM) Units	Tetrachloroethene (µg/L)	Trichloroethene (µg/L)
Flow in Sub-Drain System				
Alternate 357	Cleanout CO-6	23	**10**	**8.4**
358	Cleanout CO-4	59	**7.0**	**15**
359	Cleanout CO-1	62	**4.6**	**12**
360	Tightline Pipe Outfall	155	**4.0**	**11**
Treatment Lagoon Inflows (Non-Sub-Drain)				
350	M Street Storm Drain Outfall	71	0.20 U	**1.2**
356	Watercourse Upstream of Lagoon	NC	0.20 U	0.20 U
362	M Street Terminus Catch Basin Outfall (rarely flows)	NF	NS	NS
Treatment Lagoon Effluent				
361	Lagoon Effluent	803	**0.30**	**0.95**
Deschutes River Point of Compliance				
364	Deschutes River Outfall	2,419	0.20 U	**0.50**
	Deschutes River Discharge Remediation Goal		0.8	2.7

Table 6B

Summer 2014 Discharge Volume and Analytical Results - Subdrain and Lagoon

2014 Annual Groundwater Monitoring Report

Palermo Wellfield Superfund Site

Tumwater, Washington

Location	Station Description	Volume (GPM) Units	Tetrachloroethene (µg/L)	Trichloroethene (µg/L)
Flow in Sub-Drain System				
357	Cleanout CO-6	54	**12**	**6.0**
358	Cleanout CO-4	81	**8.0**	**14**
359	Cleanout CO-1	170	**4.3**	**10**
360	Tightline Pipe Outfall	151	**4.4**	**11**
Treatment Lagoon Inflows (Non-Sub-Drain)				
350	M Street Storm Drain Outfall	22	0.20 U	**1.0**
356	Watercourse Upstream of Lagoon	NC	0.20 U	0.20 U
362	M Street Terminus Catch Basin Outfall (rarely flows)	NF	NS	NS
Treatment Lagoon Effluent				
361	Lagoon Effluent	329	**0.30**	**0.82**
Deschutes River Point of Compliance				
364	Deschutes River Outfall	625	**0.20**	**0.50**
	Deschutes River Discharge Remediation Goal		0.8	2.7

Notes:

GPM = gallons per minute

µg/L = microgram per liter

NG = no remediation goal

NS = not sampled

NF = no flow; not calculated

NC = not calculated because flow was too slow to measure

J = estimated concentration

U = parameter not detected above the reporting limit

Bold font type indicates analyte was detected

Exceeds remediation goal

*Quantitation limit above site remediation goal

Samples were also analyzed for 1,1-DCE, trans-1,2-DCE, cis-1,2-DCE and vinyl chloride but were not detected.

Table 7

Sediment Accumulation in Catch Basins and Cleanouts in Subdrain System

2014 Annual Groundwater Monitoring Report
Palermo Wellfield Superfund Site
Tumwater, Washington

Location	Depth to Water (feet)	Water Elevation (feet, NGVD)	Original Total Depth (Feb. 2001) (feet)	Measured Total Depth (feet)	Net Change (feet)	Catch Basin and Subdrain Cleanout Observations
Spring 2014						
CB-1	5.05	N/A	7.78	7.86	-0.08	Gravel flowing in from west invert and being deposited in sump. Inverts partially submerged.
CB-2	6.55	N/A	8.78	8.80	-0.02	Debris in sump (sand, rocks, asphalt), fast flow, soft sump bottom. South and east inverts partially submerged.
CB-3	8.93	N/A	8.81	9.13	-0.32	Free of debris, fast flow, soft sump bottom. Both inverts partially submerged.
CO-1 (359)	6.01	102.38	7.82	7.74	0.08	Free of debris, fast flow, soft sump bottom. South and east inverts fully submerged.
CO-2	5.45	102.59	7.10	7.19	-0.09	Free of debris, moderate flow, soft sump bottom. All inverts fully submerged.
CO-3	5.17	102.80	6.84	6.78	0.06	Sediment in sump, slow flow, soft sump bottom. All inverts fully submerged.
CO-4 (358)	5.88	102.85	7.84	7.40	0.44	Free of debris, moderate flow. South and east inverts are completely submerged. North invert is mostly submerged.
CO-5	6.30	103.02	7.84	7.79	0.05	Tree roots present in bottom of sump, moderate flow. North and south inverts partially submerged. East invert fully submerged.
CO-6 (357)	6.20	103.58	7.70	7.46	0.24	Free of debris, slow flow, soft sump bottom. Water sample has faint hydrogen sulfide odor. Worms observed in water. All inverts submerged.
CO-7	6.72	104.01	7.89	7.81	0.08	South pipe invert is partially submerged, some sediment in pipe. East pipe invert partially submerged. North pipe invert partially submerged.
CO-8	6.75	104.21	8.10	7.47	0.63	Free of debris, slow flow. East pipe invert finger drain is completely submerged. North pipe invert is partially submerged.
Fall 2014						
CB-1	5.15	N/A	7.78	7.81	-0.03	Free of debris, moderate flow, soft sump bottom.
CB-2	6.6	N/A	8.78	8.72	0.06	Gravel debris deposited in sump bottom, moderate flow.
CB-3	6.24	N/A	8.81	8.78	0.03	Free of debris, moderate flow, soft sump bottom.
CO-1 (359)	6.45	101.94	7.82	7.75	0.07	Free of debris, moderate flow, turbulent, soft sump bottom.
CO-2	5.83	102.21	7.10	7.18	-0.08	Free of debris, moderate flow.
CO-3	6.24	101.73	6.84	6.72	0.12	Free of debris, moderate flow, soft sump bottom.
CO-4 (358)	6.19	102.54	7.84	7.05	0.79	Free of debris, moderate flow, soft sump bottom.
CO-5	6.57	102.75	7.84	7.57	0.27	Free of debris, moderate flow.
CO-6 (357)	6.45	103.33	7.70	7.52	0.18	Free of debris, slow flow.
CO-7	6.70	104.03	7.89	7.45	0.44	Free of debris, slow flow, soft sump bottom.
CO-8	6.75	104.21	8.10	7.36	0.74	Extremely slow flow, lid of manhole broke and fell inside cleanout. Manhole was replaced by the City of Tumwater.

Notes:

Exceeds 0.5 foot accumulated sediment (Section 4.2.1 Trunk Drain, O&M Manual, URS 2002)

N/A = Not applicable

NM = Not measured

NGVD = National Geodetic Vertical Datum 1929

Table 8

Subdrain Performance

2014 Annual Groundwater Monitoring Report
Palermo Wellfield Superfund Site
Tumwater, Washington

Compliance Station	Ground Surface Elevation [1] (feet)	Compliance Groundwater Elevation [2] (feet)	Depth to Water from Ground Surface (feet) [3]	3 Foot Elevation Reduction Met
Spring 2014				
PZ-720	108.22	105.22	3.34	Yes
PZ-721	108.57	105.57	2.90	No
PZ-722	109.21	106.21	-0.60	No
Summer 2014				
PZ-720	108.22	105.22	4.52	Yes
PZ-721	108.57	105.57	3.47	Yes
PZ-722	109.21	106.21	-0.23	No

Notes:

[1]Elevations in NGVD 29. Surveyed by White Shield for URS January 5, 2000.

[2]Compliance groundwater elevation is 3 feet below ground surface, also equivalent to 18 inches below crawlspace floors.

[3]Depth to water is related to ground surface elevation and not from top of casing elevation.

FIGURES

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Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. TW-3, TW-16 and TW-17 are installed but not operating. TW-2 and TW-5 are decommissioned.

Data Source: Long term monitoring locations provided by Parametrix 2012 and Skillings Connolly, Inc. 2014. Imagery from ESRI 2013.
Projection: NAD 1983 StatePlane Washington South FIPS 4602 Feet

- Monitoring well and identifier
- Piezometer and identifier
- Groundwater seep and identifier
- City production well and identifier
- City test well and identifier
- Stripper tower and identifier
- Barnes Lake staff gauge
- Former city production well and identifier
- Former monitoring well and identifier

N
W E
S

400 0 400
Feet

Site Plan

Palermo Wellfield Superfund Site

GEOENGINEERS

Figure 1

P:\0\0180121\GIS\MXDs\GroundWater_Monitoring\Revised_2014_AnnualReport\018012107_F1_VM.mxd Date Exported: 03/03/17 by maugust

Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. TW-3, TW-16, and TW-17 are installed but not operating.

Data Source: Long-term monitoring locations from Parametrix 2012. Subdrain layout provided by URS 2000, Imagery from ESRI 2013.
Projection: NAD 1983 StatePlane Washington South FIPS 4602 Feet

Monitoring well and identifier
Piezometer and identifier
Groundwater seep and identifier
City production well and identifier
City test well and identifier
Stripper tower and identifier
Former city production well and identifier
Catch basin and identifier
Subdrain cleanout sampling station and identifier
Treatment lagoon sampling station and identifier
Cleanout location and identifier
Subdrain tightline pipe
Subdrain perforated pipe

N
W E
S

120 0 120

Feet

Palermo Neighborhood and Subdrain

Palermo Wellfield Superfund Site

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Figure 2

P:\0\0180121\GIS\MXDs\GroundWater_Monitoring\Revised_2014_AnnualReport\0180121_07_F2_NeighborhoodSubdrain.mxd Date Exported: 02/24/17 by cchef

Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc.and will serve as the official record of this communication.
3. TW-3, TW-16 and TW-17 are installed but not operating.
4. Groundwater elevations collected April 14, 2014.
5. Groundwater elevation estimated using Surfer (Golden Software) 8.0 contouring software using the Natural Neighbor gridding method.
6. Groundwater elevations are relative to NAVD88 datum.

Data Source: Long-term monitoring locations provided by Parametrix 2012. Imagery from ESRI 2013.
Projection: NAD 1983 StatePlane Washington South FIPS 4602 Feet

Monitoring well and identifier
Piezometer and identifier
Groundwater seep and identifier
City production well and identifier
City test well and identifier
Stripper tower and identifier
Former city production well and identifier
Former monitoring well and identifier
100 Estimated groundwater elevation
NM Not Measured

N
W E
S

400 0 400
Feet

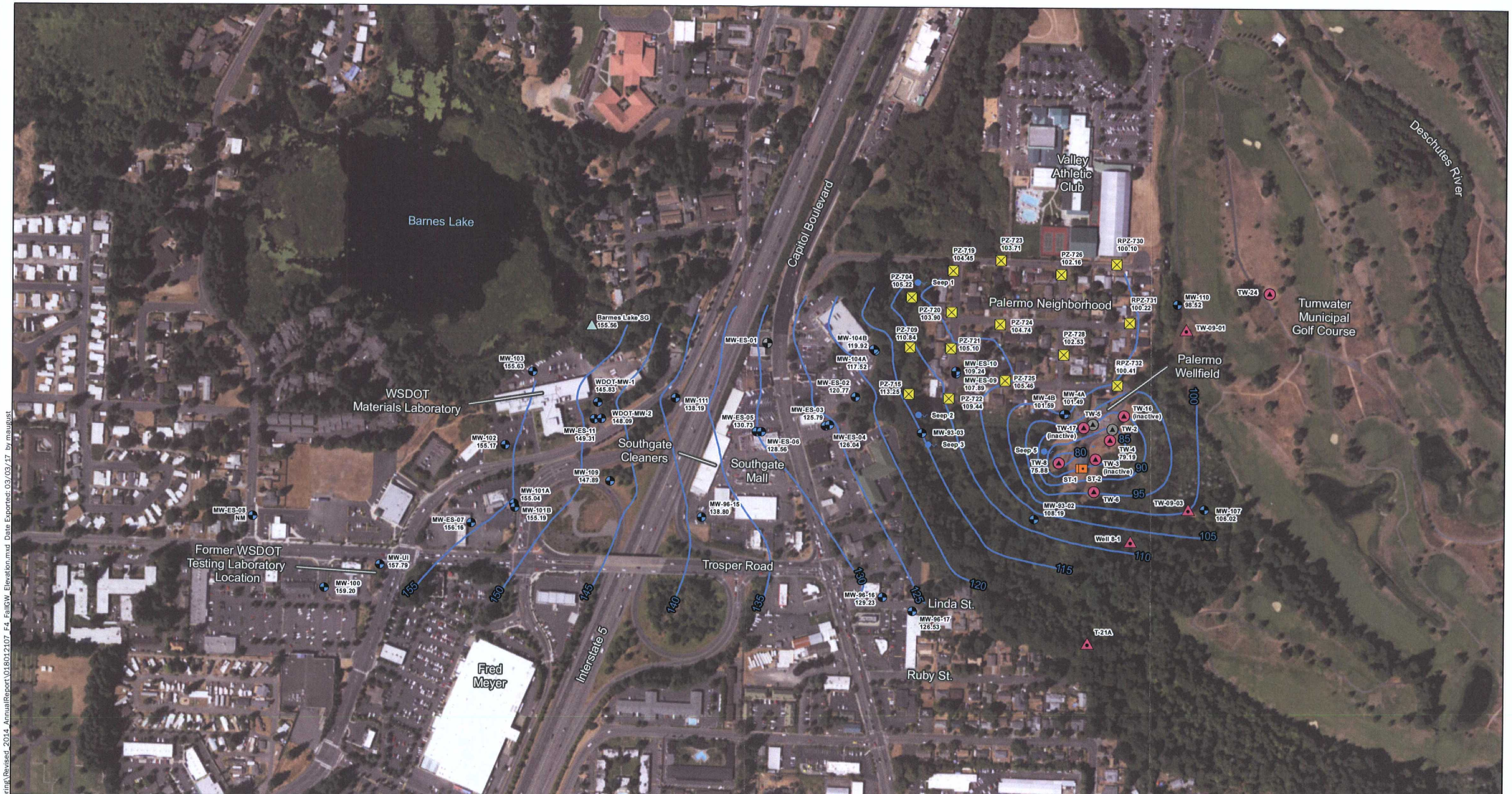
Spring 2014
Generalized Groundwater Elevations

Palermo Wellfield Superfund Site

GEOENGINEERS

Figure 3

P:\0\0180121\GIS\MXDs\GroundWater_Monitoring\Revised_2014_AnnualReport\018012107_F3_SpringGW_Elevation.mxd Date Exported: 03/03/17 by maugust



Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc.and will serve as the official record of this communication.
3. TW-3, TW-16 and TW-17 are installed but not operating.
4. Groundwater elevations collected August 29, 2014.
5. Groundwater elevation estimated using Surfer (Golden Software) 8.0 contouring software using the Natural Neighbor gridding method.
6. Groundwater elevations are relative to NAVD88 datum.

Data Source: Long-term monitoring locations provided by Parametrix 2012.
Imagery from ESRI 2013.
Projection: NAD 1983 StatePlane Washington South FIPS 4602 Feet

Monitoring well and identifier
Piezometer and identifier
Groundwater seep and identifier
City production well and identifier
City test well and identifier
Stripper tower and identifier
Barnes Lake staff gauge
Former city production well and identifier
Former monitoring well and identifier
100 Estimated groundwater elevation
NM Not Measured

N E S W

400 0 400
Feet

Fall 2014
Generalized Groundwater Elevations

Palermo Wellfield Superfund Site

GEOENGINEERS

Figure 4

P:\0\0180121\GIS\MXDs\GroundWater_Monitoring\Revised_2014_AnnualReport\018012107_F4_FallGW_Elevation.mxd Date Exported: 03/03/17 by maugust

Notes:
1. Concentrations presented in µg/L
2. The locations of all features shown are approximate.
3. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
4. TW-3, TW-16 and TW-17 are installed but not operating.
5. Groundwater samples collected from April 14 to 23, 2014.

Data Source: Long-term monitoring locations provided by Parametrix 2012.
Imagery from ESRI 2013.
Projection: NAD 1983 StatePlane Washington South FIPS 4602 Feet

Monitoring well and identifier
Piezometer and identifier
Groundwater seep and identifier
City production well and identifier
City test well and identifier
Stripper tower and identifier
Former city production well and identifier
Former monitoring well and identifier
U Compound not detected at the reporting limit
J Estimated concentration
NS Estimated concentration

N W E S
400 0 400
Feet

Spring 2014
PCE Concentrations in Groundwater (µg/L)

Palermo Wellfield Superfund Site

GEOENGINEERS

Figure 5

P:\0\0180121\GIS\MXDs\GroundWater_Monitoring\Revised_2014_AnnualReport\018012107_F5_SpringPCE.mxd Date Exported: 02/27/17 by cchelf

Notes:
1. Concentrations presented in μg/L
2. The locations of all features shown are approximate.
3. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
4. TW-3, TW-16, and TW-17 are installed but not operating.
5. Groundwater samples were collected form April 14 to 23, 2014.

Data Source: Long-term monitoring locations provided by Parametrix 2012.
Imagery from ESRI 2013.
Projection: NAD 1983 StatePlane Washington South FIPS 4602 Feet

Monitoring well and identifier
Piezometer and identifier
Groundwater seep and identifier
City production well and identifier
City test well and identifier
Stripper tower and identifier
Former city production well and identifier
Former monitoring well and identifier
U Compound not detected at the reporting limit
J Estimated concentration
NS Not Sampled

N W E S

400 0 400
Feet

Spring 2014
TCE Concentrations in Groundwater (μg/L)

Palermo Wellfield Superfund Site

GeoEngineers

Figure 6

P:\0\0180121\GIS\MXDs\GroundWater_Monitoring\Revised_2014_AnnualReport\018012107_F6_SpringTCE.mxd Date Exported: 02/27/17 by ccheif

P:\0\0180121\GIS\MXDs\GroundWater_Monitoring\Revised_2014_AnnualReport\0180121107_F7_FallPCE.mxd Date Exported: 02/27/17 by cchelf

Notes:
1. Concentrations presented in µg/L
2. The locations of all features shown are approximate.
3. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
4. TW-3, TW-16 and TW-17 are installed but not operating.
5. Groundwater samples collected from August 18 to 28, 2014.

Data Source: Long-term monitoring locations provided by Parametrix 2012.
Imagery from ESRI 2013.
Projection: NAD 1983 StatePlane Washington South FIPS 4602 Feet

Monitoring well and identifier
Piezometer and identifier
Groundwater seep and identifier
City production well and identifier
City test well and identifier
Stripper tower and identifier
Barnes Lake staff gauge
Former city production well and identifier
Former monitoring well and identifier
U Compound not detected at the reporting limit
J Estimated concentration
NS Estimated concentration

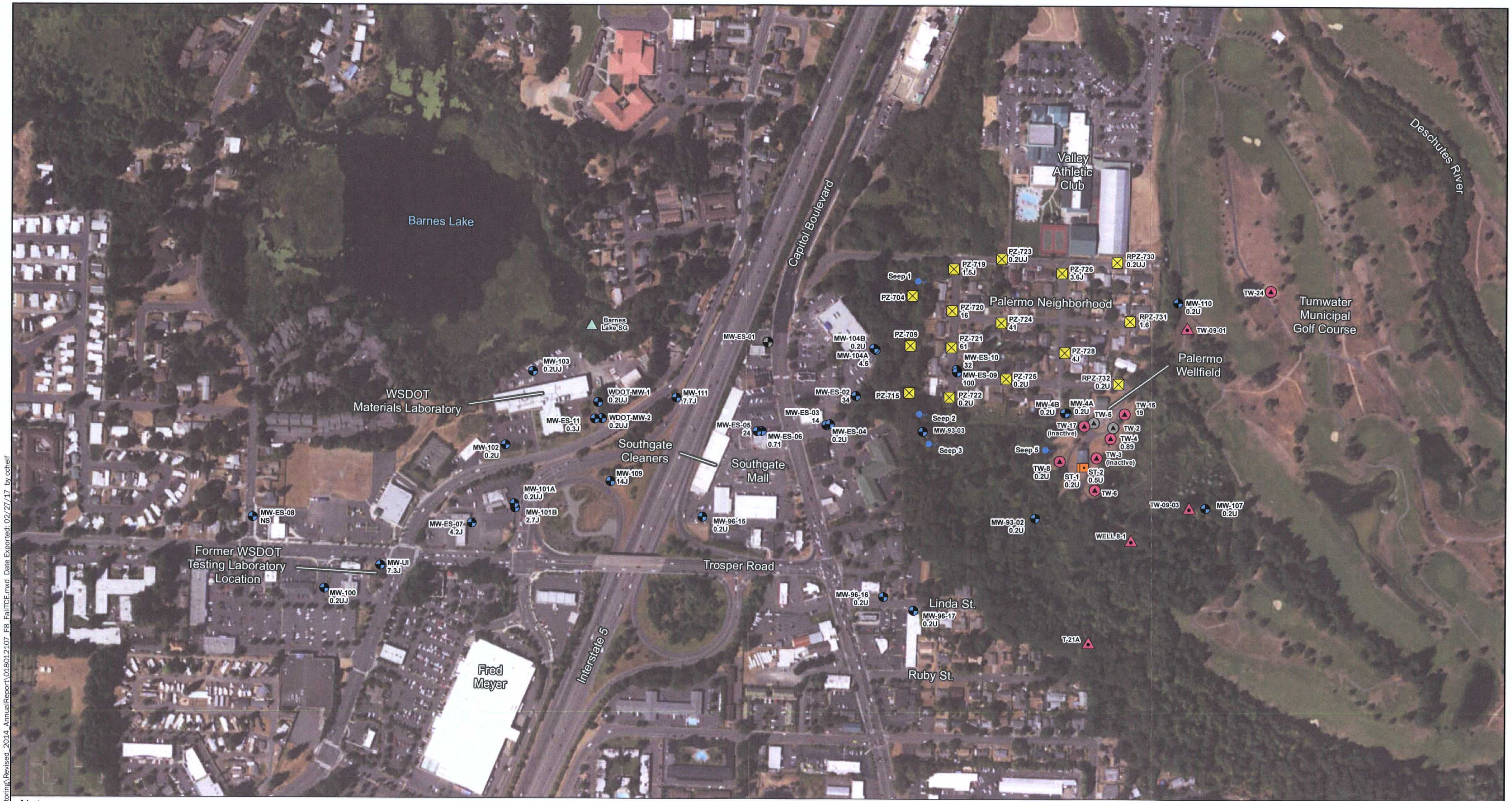
N
W E
S
400 0 400
Feet

Fall 2014
PCE Concentrations in Groundwater (µg/L)

Palermo Wellfield Superfund Site

GEOENGINEERS

Figure 7



Notes:
1. Concentrations presented in μg/L
2. The locations of all features shown are approximate.
3. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
4. TW-3, TW-16 and TW-17 are installed but not operating.
5. Groundwater samples were collected form August 18 to August 28, 2014.

Data Source: Long-term monitoring locations provided by Parametrix 2012.
Imagery from ESRI 2013.
Projection: NAD 1983 StatePlane Washington South FIPS 4602 Feet

Monitoring well and identifier
Piezometer and identifier
Groundwater seep and identifier
City production well and identifier
City test well and identifier
Stripper tower and identifier
Barnes Lake staff gauge
Former city production well and identifier
Former monitoring well and identifier
U Compound not detected at the reporting limit
J Estimated concentration
NS Not Sampled

N W E S

400 0 400
Feet

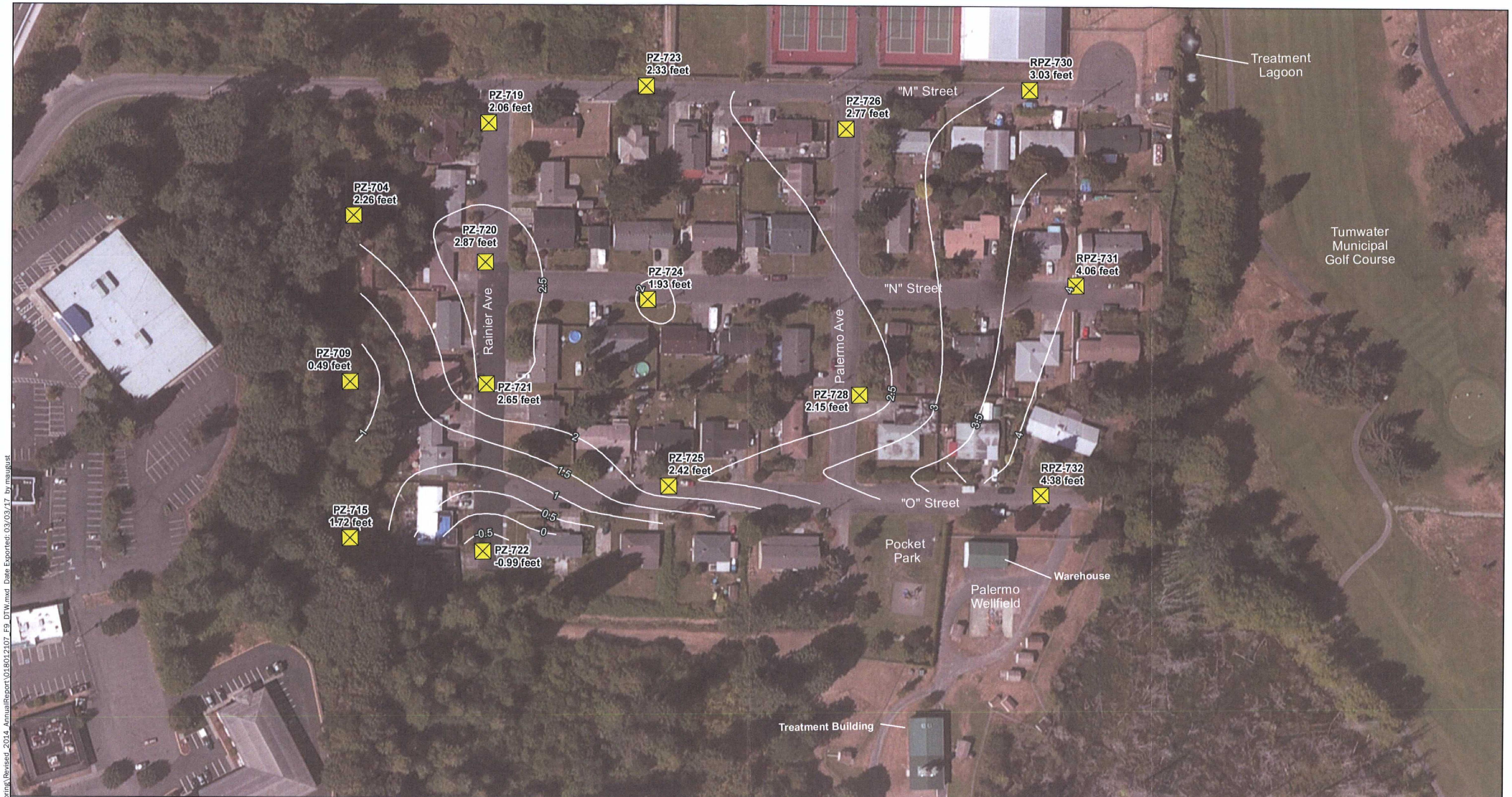
Fall 2014
TCE Concentrations in Groundwater (μg/L)

Palermo Wellfield Superfund Site

GEOENGINEERS

Figure 8

P:\0\0180121\GIS\MXDs\GroundWater_Monitoring\Revised_2014_AnnualReport\018012107_F8_FallTCE.mxd Date Exported: 02/27/17 by ccheif



Notes:

1. Depth to water measurements were made on April 14, 2014.
2. The locations of all features shown are approximate.
3. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
4. Contours were generated using Surfer 8.0 (Golden Software) contouring software using the natural neighbor gridding method.
5. Depth to water measurements at flush-mounted monitoring wells are calculated from the tops-of-casings, which are slightly below the flush-mounted monument.

Data Source: Elevation Datum Reference: NAVD88.
Imagery From ESRI 2013
Projection: NAD 1983 StatePlane Washington South FIPS 4602 Feet

Piezometer, identifier, and depth to groundwater

Estimated or inferred goundwater depth-to-water contours (piezometers)

N W E S

120 0 120
Feet

Spring 2014
Estimated Depth to Groundwater

Palermo Wellfield Superfund Site

GEOENGINEERS

Figure 9

P:\0\0180121\GIS\MXDs\GroundWater_Monitoring\Revised_2014_AnnualReport\0180121207_F9_DTW.mxd Date Exported: 03/03/17 by maugust

Notes:
1. Depth to water measurements were made August 29, 2014.
2. The locations of all features shown are approximate.
3. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
4. Contours were generated using Surfer 8.0 (Golden Software) contouring software using the natural neighbor gridding method.
5. Depth to water measurements at wells with flush-mounted completions are calculated from the tops-of-casings, which are slightly below the flush-mounted monument.
6. Depth to water measurements from PZ-704, PZ-709 and PZ-715 have been adjusted to reflect below ground surface measurements. Those locations have above ground surface completions.

Data Source: Elevation Datum Reference: NAVD88. Imagery From ESRI 2013
Projection: NAD 1983 StatePlane Washington South FIPS 4602 Feet

Piezometer, identifier, and depth to groundwater

Estimated or inferred groundwater depth-to-water contours (piezometers)

N W E S

120 0 120
Feet

Fall 2014
Estimated Depth to Groundwater

Palermo Wellfield Superfund Site

GEOENGINEERS

Figure 10

P:\0\0180121\GIS\MXDs\GroundWater_Monitoring\Revised_2014_AnnualReport\018012107_F10_Fall_DTW.mxd Date Exported: 03/03/17 by maugust

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. TW-3, TW-16 and TW-17 are installed but not operating.
4. Subdrain and lagoon samples were collected on April 29, 2014.

Data Source: Long-term monitoring locations from Parametrix 2012. Subdrain layout provided by URS 2000, Imagery from ESRI 2013.
Projection: NAD 1983 StatePlane Washington South FIPS 4602 Feet

Monitoring well and identifier
Piezometer and identifier
Groundwater seep and identifier
City production well and identifier
City test well and identifier
Stripper tower and identifier
Former city production well and identifier
Catch basin and identifier
Subdrain cleanout sampling station and identifier
Treatment lagoon sampling station and identifier
Cleanout location and identifier
U Compound not detected at the reporting limit
J Estimated concentration
NC Not calculated
Subdrain tightline pipe
Subdrain perforated pipe

N E S W

120 0 120
Feet

Spring 2014 - Subdrain and Treatment Lagoon Monitoring Results Palermo Neighborhood

Palermo Wellfield Superfund Site

GEOENGINEERS

Figure 11

P:\0\0180121\GIS\MXDs\GroundWater_Monitoring\Revised_2014_AnnualReport\0180121207_F11_SpringPCE_TCE.mxd Date Exported: 02/24/17 by cchelf

Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. TW-3, TW-16 and TW-17 are installed but not operating.
4. Subdrain and lagoon samples were collected on August 26, 2014.

Data Source: Long-term monitoring locations from Parametrix 2012. Subdrain layout provided by URS 2000, Imagery from ESRI 2013.
Projection: NAD 1983 StatePlane Washington South FIPS 4602 Feet

Monitoring well and identifier
Piezometer and identifier
Groundwater seep and identifier
City production well and identifier
City test well and identifier
Stripper tower and identifier
Former city production well and identifier
Catch basin and identifier
Subdrain cleanout sampling station and identifier
Treatment lagoon sampling station and identifier
Cleanout location and identifier
U Compound not detected at the reporting limit
J Estimated concentration
NC Not calculated
Subdrain tightline pipe
Subdrain perforated pipe

N W E S

120 0 120
Feet

Fall 2014 - Subdrain and Treatment Lagoon Monitoring Results Palermo Neighborhood

Palermo Wellfield Superfund Site

GEOENGINEERS

Figure 12

P:\0\0180121\GIS\MXDs\GroundWater_Monitoring\Revised_2014_AnnualReport\018012107_F12_FallPCE_TCE.mxd Date Exported: 02/24/17 by cchelf

APPENDICES

GeoEngineers

APPENDIX A
Field Forms
(Included on CD)

APPENDIX B
Analytical Data Summary Tables

Table B-1

Groundwater Results

Spring 2014 Groundwater Monitoring Report
Palermo Wellfield Superfund Site
Tumwater, Washington

Location	Sample ID	Date	Type	1,1-Dichloroethene (µg/L)	1,2-Dichloroethane (µg/L)	cis-1,2-Dichloroethene (µg/L)	Tetrachloroethene (µg/L)	Trans-1,2-Dichloroethene (µg/L)	Trichloroethene (µg/L)	Vinyl Chloride (µg/L)
MW-100	MW-100-140415	4/15/2014	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
MW-101A	MW-101A-140415	4/15/2014	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
MW-101B	MW-101B-140415	4/15/2014	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	**2.9**	0.20 U
MW-102	MW-102-140417	4/17/2014	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
MW-102	DUP-2-140417	4/17/2014	Duplicate	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
MW-103	MW-103-140416	4/16/2014	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
MW-104A	MW-104A-140418	4/18/2014	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	**3.9**	0.20 U
MW-104B	MW-104B-140418	4/18/2014	Primary	0.20 U	0.20 U	0.20 U	**0.99**	0.20 U	0.20 U	0.20 U
MW-107	MW-107-140418	4/18/2014	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
MW-109	MW-109-140416	4/16/2014	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	**15**	0.20 U
MW-110	MW-110-140418	4/18/2014	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
MW-111	MW-111-140416	4/16/2014	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	**8.4**	0.20 U
MW-4A	MW-4A-140422	4/22/2014	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
MW-4A	DUP-2-140422	4/22/2014	Duplicate	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
MW-4B	MW-4B-140422	4/22/2014	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
MW-93-02	MW-93-02-140417	4/17/2014	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
MW-96-15	MW-96-15-140417	4/17/2014	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
MW-96-16	MW-96-16-140416	4/16/2014	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
MW-96-17	MW-96-17-140415	4/15/2014	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
MW-ES-02	MW-ES-02-140421	4/21/2014	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	**39**	0.20 U
MW-ES-03	MW-ES-03-140417	4/17/2014	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	**16**	0.20 U
MW-ES-04	MW-ES-04-140417	4/17/2014	Primary	0.20 U	0.20 U	0.20 U	**34**	0.20 U	**0.31**	0.20 U
MW-ES-05	MW-ES-05-140421	4/21/2014	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	**25**	0.20 U
MW-ES-05	DUP-2-140421	4/21/2014	Duplicate	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	**25**	0.20 U
MW-ES-06	MW-ES-06-140421	4/21/2014	Primary	0.20 U	0.20 U	0.20 U	**13**	0.20 U	**1.1**	0.20 U
MW-ES-07	MW-ES-07-140415	4/15/2014	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	**4.3**	0.20 U
MW-ES-09	MW-ES-09-140421	4/21/2014	Primary	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**110**	1.0 U
MW-ES-10	MW-ES-10-140422	4/22/2014	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	**35**	0.20 U
MW-ES-11	MW-ES-11-140417	4/17/2014	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	**0.22**	0.20 U
MW-UI	MW-UI-140415	4/15/2014	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	**7.9**	0.20 U
PZ-704	PZ-704-140421	4/21/2014	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
PZ-709	PZ-709-140421	4/21/2014	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
PZ-715	PZ-715-140421	4/21/2014	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
PZ-719	PZ-719-140418	4/18/2014	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	**1.8**	0.20 U
PZ-720	PZ-720-140418	4/18/2014	Primary	0.20 U	0.20 U	0.20 U	**0.40**	0.20 U	**5.5**	0.20 U
PZ-721	PZ-721-140422	4/22/2014	Primary	0.20 U	0.20 U	**0.28**	0.20 U	0.20 U	**37**	0.20 U
PZ-721	DUP-1-140422	4/22/2014	Duplicate	0.20 U	0.20 U	**0.27**	0.20 U	0.20 U	**37**	0.20 U
PZ-722	PZ-722-140422	4/22/2014	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
PZ-723	PZ-723-140423	4/23/2014	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
PZ-724	PZ-724-140422	4/22/2014	Primary	0.20 U	0.20 U	**0.92**	0.20 U	0.20 U	**29**	0.20 U
PZ-725	PZ-725-140422	4/22/2014	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
PZ-726	PZ-726-140423	4/23/2014	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	**3.1**	0.20 U
PZ-728	PZ-728-140423	4/23/2014	Primary	0.20 U	0.20 U	**0.23**	0.20 U	0.20 U	**4.2**	0.20 U
RPZ-730	RPZ-730-140423	4/23/2014	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
RPZ-731	RPZ-731-140423	4/23/2014	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	**0.65**	0.20 U
RPZ-732	RPZ-732-140422	4/22/2014	Primary	0.20 U	0.20 U	0.20 U	**0.23**	0.20 U	0.20 U	0.20 U
WDOT-MW-1	WDOT-MW-1-140416	4/16/2014	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
WDOT-MW-2	WDOT-MW-2-140416	4/16/2014	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U

Notes:

µg/L = micrograms per liter

U = not detected at or above the reported detection limit

Bold = detected result above the method detection limit.

Table B-2

Subdrain Results

Spring 2014 Groundwater Monitoring Report
Palermo Wellfield Superfund Site
Tumwater, Washington

Location	Sample ID	Date	Type	1,1-Dichloroethene (µg/L)	1,2-Dichloroethane (µg/L)	cis-1,2-Dichloroethene (µg/L)	Tetrachloroethene (µg/L)	Trans-1,2-Dichloroethene (µg/L)	Trichloroethene (µg/L)	Vinyl Chloride (µg/L)
Sub-Drain System										
350	350-140429	4/29/2014	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	**1.2**	0.20 U
356	356-140429	4/29/2014	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
357	CO-6-140429	4/29/2014	Primary	0.20 U	0.20 U	0.20 U	**10**	0.20 U	**8.4**	0.20 U
358	CO-4-140429	4/29/2014	Primary	0.20 U	0.20 U	0.20 U	**7.0**	0.20 U	**15**	0.20 U
359	CO-1-140429	4/29/2014	Primary	0.20 U	0.20 U	0.20 U	**4.6**	0.20 U	**12**	0.20 U
360	360-140429	4/29/2014	Primary	0.20 U	0.20 U	0.20 U	**4.0**	0.20 U	**11**	0.20 U
361	361-140429	4/29/2014	Primary	0.20 U	0.20 U	0.20 U	**0.30**	0.20 U	**0.95**	0.20 U
364	364-140429	4/29/2014	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	**0.50**	0.20 U
Seeps										
Seep 1	SEEP-1-140421	4/21/2014	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Seep 2	SEEP-2-140421	4/21/2014	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Seep 3	SEEP-3-140421	4/21/2014	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Seep 5	SEEP-5-140421	4/21/2014	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Seep 5	DUP-1-140421	4/21/2014	Duplicate	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Wellfield Samples										
ST-1	ST-1-140418	4/18/2014	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
TW-4	TW-4-140418	4/18/2014	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	**0.43**	0.20 U
TW-8	TW-8-140418	4/18/2014	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
TW-16	TW-16-140418	4/18/2014	Primary	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	**9.6**	0.20 U

Notes:

µg/L = micrograms per liter

U = not detected at or above the reported detection limit

Bold = detected result above the method detection limit.

APPENDIX C
Data Validation Reports

GeoEngineers

1101 Fawcett Avenue, Suite 200, Tacoma, Washington 98402, Telephone: 253.383.4940, Fax: 253.383.4923 www.geoengineers.com

Data Validation Report

Project: Palermo Wellfield Remedial Investigation and Feasibility Study
April 2014 Semiannual Groundwater Monitoring

GEI File No: 00180-121-09

Date: May 16, 2014

This report documents the results of a United States Environmental Protection Agency (USEPA)-defined Stage 2B data validation (USEPA Document 540-R-08-005; USEPA, 2009) of analytical data from the analyses of groundwater samples collected as part of the April 2014 Semiannual Groundwater sampling event, and the associated laboratory and field quality control (QC) samples. The samples were obtained from the Palermo Wellfield Superfund Site located in Tumwater, Washington.

OBJECTIVE AND QUALITY CONTROL ELEMENTS

GeoEngineers, Inc. (GeoEngineers) completed the data validation consistent with USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review (USEPA, 2008) (National Functional Guidelines) to determine if the laboratory analytical results meet the project objectives and are usable for their intended purpose. Data usability was assessed by determining if:

- The samples were analyzed using well-defined and acceptable methods that provide reporting limits below applicable regulatory criteria;
- The precision and accuracy of the data are well-defined and sufficient to provide defensible data; and
- The quality assurance/quality control (QA/QC) procedures utilized by the laboratory meet acceptable industry practices and standards.

In accordance with the Field Sampling Plan (GeoEngineers, 2013), the data validation included review of the following QC elements:

- Data Package Completeness
- Chain-of-Custody Documentation
- Holding Times and Sample Preservation
- Surrogate Recoveries
- Method, Trip, and Rinsate Blanks
- Matrix Spikes/Matrix Spike Duplicates
- Laboratory Control Samples/Laboratory Control Sample Duplicates
- Field Duplicates
- Internal Standards
- Initial Calibrations (ICALs)
- Continuing Calibrations (CCALs)
- Reporting Limits

VALIDATED SAMPLE DELIVERY GROUPS

This data validation included review of the sample delivery groups (SDGs) listed below in Table 1.

TABLE 1: SUMMARY OF VALIDATED SAMPLE DELIVERY GROUPS

Laboratory SDG	Samples Validated
1404-122	MW-101A-140415, MW-101B-140415, MW-ES-07-140415, RIN-2-140415, TB-2-140415
1404-123	MW-96-17-140415, MW-100-140415, MW-UI-140415, RIN-1-140415, TB-1-140415
1404-137	MW-96-16-140416, MW-109-140416, MW-111-140416, RIN-1-140416, TB-1-140416
1404-138	MW-103-140416, WDOT-MW-1-140416, WDOT-MW-2-140416, RIN-2-140416, TB-2-140416
1404-156	MW-93-02-140417, MW-96-15-140417, MW-ES-03-140417, RIN-1-140417, TB-1-140417
1404-157	MW-102-140417, DUP-2-140417, MW-ES-04-140417, MW-ES-11-140417, RIN-2-140417, TB-2-140417
1404-167	MW-107-140418, MW-110-140418, PZ-719-140418, PZ-720-140418, RIN-1-140418, TB-1-140418
1404-168	MW-104A-140418, MW-104B-140418, ST-1-140418, TW-4-140418, TW-8-140418, TW-16-140418, RIN-2-140418, TB-2-140418
1404-179	PZ-704-140421, PZ-709-140421, PZ-715-140421, SEEP-1-140421, SEEP-2-140421, SEEP-3-140421, SEEP-5-140421, DUP-1-140421, TB-1-140421
1404-180	MW-ES-02-140421, MW-ES-05-140421, DUP-2-140421, MW-ES-06-140421, MW-ES-09-140421, RIN-2-140421, TB-2-140421
1404-198	PZ-721-140422, DUP-1-140422, PZ-722-140422, PZ-724-140422, PZ-725-140422, RPZ-732-140422, TB-1-140422
1404-199	MW-4A-140422, DUP-2-140422, MW-4B-140422, MW-ES-10-140422, RIN-2-140422, TB-2-140422
1404-204	PZ-723-140423, PZ-726-140423, PZ-728-140423, RPZ-730-140423, RPZ-731-140423, TB-1-140423

CHEMICAL ANALYSIS PERFORMED

OnSite Environmental, Inc. (OnSite), located in Redmond, Washington, performed laboratory analysis on the groundwater samples using the following method:

- Volatile Organic Compounds (VOCs) by Method SW8260C

DATA VALIDATION SUMMARY

The results for each of the QC elements are summarized below.

Data Package Completeness

OnSite provided all required deliverables for the data validation according to the National Functional Guidelines. The laboratory followed adequate corrective action processes and all identified anomalies were discussed in the relevant laboratory case narrative.

Chain-of-Custody Documentation

Chain-of-custody (COC) forms were provided with the laboratory analytical reports. The COCs were accurate and complete when submitted to the lab with the exceptions identified below.

SDG 1404-122: The laboratory noted that Sample MW-ES-07-140415 was mislabeled as MW-E7-07-140415 on the sample label.

The laboratory noted that Sample MW-101B-140415 had one vial with a bubble. It was determined through professional judgment by Onsite that since the bubble was small, it would likely not affect the sample results. GeoEngineers agrees with this assessment.

SDG 1404-167: The laboratory noted that Sample PZ-719-140418 was mislabeled as PZ-719 on the sample label.

SDG 1404-179: The laboratory noted that Sample TB-1-140421 was received with two containers. The sample was listed with three containers on the COC. The COC was changed to reflect this by OnSite.

Holding Times and Sample Preservation

The sample holding time is defined as the time that elapses between sample collection and sample analysis. Maximum holding time criteria exist for each analysis to help ensure that the analyte concentrations found at the time of analysis reflect the concentration present at the time of sample collection. Established holding times were met for all analyses. The sample coolers arrived at the laboratory at the appropriate temperatures of between two and six degrees Celsius, with exceptions where the temperature was slightly below the lower limit, but above freezing. The out-of-compliance temperatures are detailed below.

SDG 1404-122: The sample cooler temperature recorded at the laboratory was zero degrees Celsius. It was determined through professional judgment that since the samples were not frozen, this temperature should not affect the sample analytical results.

SDG 1404-123: The sample cooler temperature recorded at the laboratory was one degree Celsius. It was determined through professional judgment that since the samples were not frozen, this temperature should not affect the sample analytical results.

SDG 1404-137: The sample cooler temperature recorded at the laboratory was zero degrees Celsius. It was determined through professional judgment that since the samples were not frozen, this temperature should not affect the sample analytical results.

SDG 1404-138: The sample cooler temperature recorded at the laboratory was zero degrees Celsius. It was determined through professional judgment that since the samples were not frozen, this temperature should not affect the sample analytical results.

SDG 1404-156: The sample cooler temperature recorded at the laboratory was zero degrees Celsius. It was determined through professional judgment that since the samples were not frozen, this temperature should not affect the sample analytical results.

SDG 1404-157: The sample cooler temperature recorded at the laboratory was one degree Celsius. It was determined through professional judgment that since the samples were not frozen, this temperature should not affect the sample analytical results.

SDG 1404-167: The sample cooler temperature recorded at the laboratory was zero degrees Celsius. It was determined through professional judgment that since the samples were not frozen, this temperature should not affect the sample analytical results.

SDG 1404-168: The sample cooler temperature recorded at the laboratory was one degree Celsius. It was determined through professional judgment that since the samples were not frozen, this temperature should not affect the sample analytical results.

SDG 1404-179: The sample cooler temperature recorded at the laboratory was one degree Celsius. It was determined through professional judgment that since the samples were not frozen, this temperature should not affect the sample analytical results.

Surrogate Recoveries

A surrogate compound is a compound that is chemically similar to the organic analytes of interest, but unlikely to be found in any environmental sample. Surrogates are used for organic analyses and are added to all samples, standards, and blanks to serve as an accuracy and specificity check of each analysis. The surrogates are added to the samples at a known concentration and percent recoveries are calculated following analysis. All surrogate percent recoveries for field samples were within the laboratory control limits.

Method, Trip, and Rinsate Blanks

Method blanks are analyzed to ensure that laboratory procedures and reagents do not introduce measurable concentrations of the analytes of interest. A method blank was analyzed with each batch of samples, at a frequency of 1 per 20 samples. For all sample batches, method blanks were analyzed at the required frequency. None of the analytes of interest were detected above the reporting limits in any of the method blanks.

Trip blanks are analyzed to provide an indication as to whether volatile compounds have cross-contaminated other like samples within the transportation process to the laboratory. Thirteen trip blanks were collected (one for each cooler): TB-1-140415, TB-2-140415, TB-1-140416, TB-2-140416, TB-1-140417, TB-2-140417, TB-1-140418, TB-2-140418, TB-1-140421, TB-2-140421, TB-1-140422, TB-2-140422, and TB-1-140423. None of the analytes of interest were detected above the reporting limits in any of the trip blanks.

Equipment rinsate blanks are analyzed to provide an indication as to whether field decontamination and sampling procedures effectively prevent cross-contamination in field activities. Ten equipment rinsate blanks were collected: RIN-1-140415, RIN-2-140415, RIN-1-140416, RIN-2-140416, RIN-1-140417, RIN-2-140417, RIN-1-140418, RIN-2-140418, RIN-2-140421, and RIN-2-140422. None of the analytes of interest were detected above the reporting limits in any of the rinsate blanks.

Matrix Spikes/Matrix Spike Duplicates

Since the actual analyte concentration in an environmental sample is not known, the accuracy of a particular analysis is usually inferred by performing a matrix spike (MS) analysis on one sample from the associated batch, known as the parent sample. One aliquot of the sample is analyzed in the normal manner and then a second aliquot of the sample is spiked with a known amount of analyte concentration and analyzed. From these analyses, a percent recovery is calculated. Matrix spike duplicate (MSD) analyses are generally performed for organic analyses as a precision check and analyzed in the same sequence as a matrix spike. Using the result values from the MS and MSD, the relative percent difference (RPD) is calculated. The percent recovery control limits for MS and MSD analyses are specified in the laboratory documents, as are the RPD control limits for MS/MSD sample sets.

One MS/MSD analysis should be performed for every analytical batch or every 20 field samples, whichever is more frequent. The frequency requirements were met for all analyses and the percent recovery and RPD values were within the proper control limits.

Laboratory Control Samples/Laboratory Control Sample Duplicates

A laboratory control sample (LCS) is a blank sample that is spiked with a known amount of analyte and then analyzed. An LCS is similar to an MS, but without the possibility of matrix interference. Given that matrix interference is not an issue, the LCS/LCSD control limits for accuracy and precision are usually more rigorous than for MS/MSD analyses. Additionally, data qualification based on LCS/LCSD analyses would apply to all samples in the associated batch, instead of just the parent sample. The percent recovery control limits for LCS and LCSD analyses are specified in the laboratory documents, as are the RPD control limits for LCS/LCSD sample sets.

One LCS/LCSD analysis should be performed for every analytical batch or every 20 field samples, whichever is more frequent. The frequency requirements were met for all analyses and the percent recovery and RPD values were within the proper control limits.

Field Duplicates

In order to assess precision, field duplicate samples were collected and analyzed along with the reviewed sample batches. The duplicate samples were analyzed for the same parameters as the associated parent samples. Precision is determined by calculating the RPD between each pair of samples. If one or more of the sample analytes has a concentration greater than five times the reporting limit for that sample, then the absolute difference is used instead of the RPD. The RPD control limit for water samples is 20 percent.

SDG 1404-157: One field duplicate sample pair, MW-102-140417 and DUP-2-140417, was submitted with this SDG. The precision criteria for all volatile target analytes were met for this sample pair.

SDG 1404-179: One field duplicate sample pair, SEEP-5-140421 and DUP-1-140421, was submitted with this SDG. The precision criteria for all volatile target analytes were met for this sample pair.

SDG 1404-180: One field duplicate sample pair, MW-ES-05-140421 and DUP-2-140421, was submitted with this SDG. The precision criteria for all volatile target analytes were met for this sample pair.

SDG 1404-198: One field duplicate sample pair, PZ-721-140422 and DUP-1-140422, was submitted with this SDG. The precision criteria for all volatile target analytes were met for this sample pair.

SDG 1404-199: One field duplicate sample pair, MW-4A-140422 and DUP-2-140422, was submitted with this SDG. The precision criteria for all volatile target analytes were met for this sample pair.

Internal Standards (Low Resolution Mass Spectrometry)

Like the surrogate, an internal standard is a compound that is chemically similar to the analytes of interest, but unlikely to be found in any environmental sample. Internal standards are used only for the mass spectrometry instrumentation and are usually added to the sample aliquot after extraction has taken place. The internal standard should be analyzed at the beginning of a 12 hour sample run and the control limits for internal standard recoveries are 50 percent to 200 percent of the calibration standard. All internal standard recoveries were within the control limits.

Initial Calibrations (ICALs)

All initial calibrations were conducted according to the laboratory methods and consisted of the appropriate number of standards. All percent relative standard deviation (%RSD) values were less than +/- 30 percent and all relative response factors (RRF) were greater than 0.05.

Continuing Calibrations (CCALs)

All continuing calibrations were conducted according to the laboratory methods and consisted of the appropriate number of standards. All percent difference (%D) values were less than +/- 25 percent and all relative response factors (RRF) were greater than 0.05.

Reporting Limits

The contract required quantitation limits (CRQL) were met by the laboratory for all target analytes throughout this sampling event.

OVERALL ASSESSMENT

As was determined by this data validation, the laboratory followed the specified analytical methods. Accuracy was acceptable, as demonstrated by the surrogate, LCS/LCSD, and MS/MSD percent recovery values. Precision was acceptable, as demonstrated by the LCS/LCSD, MS/MSD, and field duplicate RPD values.

No analytical results were qualified. All data are acceptable for the intended use.

REFERENCES

U.S. Environmental Protection Agency (USEPA). “Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use,” EPA-540-R-08-005. January 2009.

U.S. Environmental Protection Agency (USEPA). “Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review,” EPA-540-R-08-01. June 2008.

GeoEngineers, Inc., “Field Sampling Plan, Semiannual Groundwater Monitoring”, prepared for Washington State Department of Transportation. February 15, 2013.

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Data Validation Report

Project: Palermo Wellfield Remedial Investigation and Feasibility Study
August 2014 Semiannual Groundwater Monitoring

GEI File No: 00180-121-09

Date: September 11, 2014

This report documents the results of a United States Environmental Protection Agency (USEPA)-defined Stage 2B data validation (USEPA Document 540-R-08-005; USEPA, 2009) of analytical data from the analyses of groundwater samples collected as part of the August 2014 Groundwater sampling event, and the associated laboratory and field quality control (QC) samples. The samples were obtained from the Palermo Wellfield Superfund Site located in Tumwater, Washington.

OBJECTIVE AND QUALITY CONTROL ELEMENTS

GeoEngineers, Inc. (GeoEngineers) completed the data validation consistent with USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review (USEPA, 2008) (National Functional Guidelines) to determine if the laboratory analytical results meet the project objectives and are usable for their intended purpose. Data usability was assessed by determining if:

- The samples were analyzed using well-defined and acceptable methods that provide reporting limits below applicable regulatory criteria;
- The precision and accuracy of the data are well-defined and sufficient to provide defensible data; and
- The quality assurance/quality control (QA/QC) procedures utilized by the laboratory meet acceptable industry practices and standards.

In accordance with the Field Sampling Plan (GeoEngineers, 2013), the data validation included review of the following QC elements:

- Data Package Completeness
- Chain-of-Custody Documentation
- Holding Times and Sample Preservation
- Surrogate Recoveries
- Method, Trip, and Rinsate Blanks
- Matrix Spikes/Matrix Spike Duplicates
- Laboratory Control Samples/Laboratory Control Sample Duplicates
- Field Duplicates (FDs)
- Internal Standards
- Initial Calibrations (ICALs)
- Continuing Calibrations (CCALs)
- Reporting Limits

VALIDATED SAMPLE DELIVERY GROUPS

This data validation included review of the sample delivery groups (SDGs) listed below in Table 1.

TABLE 1: SUMMARY OF VALIDATED SAMPLE DELIVERY GROUPS

Laboratory SDG	Samples Validated
1408-153	PZ-719-140818, PZ-723-140818, DUPE-3-140818, PZ-726-140818, PZ-728-140818, RPZ-730-140818, TB-Team3-140818
1408-167	PZ-720-140819, PZ-721-140819, PZ-722-140819, PZ-724-140819, PZ-725-140819, RPZ-731-140819, RPZ-732-140819, TB-3-140819
1408-185	MW-100-140820, MW-ES-07-140820, MW-UI-140820, RB-3-140820, TB-3-140820
1408-202	MW-101A-140821, DUPE-3-140821, MW-101B-140821, MW-109-140821, RB-3-140821, TB-3-140821
1408-215	MW-102-140822, MW-103-140822, MW-111-140822, DUPE-3-140822, RB-3-140822, TB-3-140822
1408-227	MW-ES-11-140825, WDOT-MW-1-140825, WDOT-MW2-140825, RB-3-140825, TB-2-140825
1408-228	ST-1-140825, TW-4-140825, TW-8-140825, TB-3-140825
1408-241	MW-96-15-140826, MW-96-16-140826, MW-96-17-140826, RB-2-140826, TB-2-140826
1408-251	MW-107-140827, MW-110-140827, MW-ES-04-140827, RB-2-140827, TB-2-140827
1408-252	MW-ES-02-140827, MW-ES-03-140827, DUP-1-140827, MW-ES-05-140827, TW-16-140827, RB-1-140827, TB-1-140827
1408-267	MW-93-02-140828, MW-104A-140828, MW-104B-140828, MW-ES-06-140828, RB-1-140828, TB-1-140828
1408-268	MW-4A-140828, MW-4B-140828, MW-ES-09-140828, MW-ES-10-140828, RB-2-140828, TB-2-140828

CHEMICAL ANALYSIS PERFORMED

OnSite Environmental, Inc. (OnSite), located in Redmond, Washington, performed laboratory analysis on the groundwater samples using the following method:

- Volatile Organic Compounds (VOCs) by Method SW8260C

DATA VALIDATION SUMMARY

The results for each of the QC elements are summarized below.

Data Package Completeness

OnSite provided all required deliverables for the data validation according to the National Functional Guidelines. The laboratory followed adequate corrective action processes and all identified anomalies were discussed in the relevant laboratory case narrative.

Chain-of-Custody Documentation

Chain-of-custody (COC) forms were provided with the laboratory analytical reports. The COCs were accurate and complete when submitted to the lab. The following were noted on the sample receipt forms:

SDG 1408-241: The laboratory noted that Sample MW-96-16-140826 was received with one broken sample vial.

SDG 1408-267: The laboratory noted that Sample MW-104A-140828 was received with one broken sample vial.

Holding Times and Sample Preservation

The sample holding time is defined as the time that elapses between sample collection and sample analysis. Maximum holding time criteria exist for each analysis to help ensure that the analyte concentrations found at the time of analysis reflect the concentration present at the time of sample collection. Established holding times were met for all analyses. The samples within all cooler containers were properly protected with bubble wrap, preserved with wet ice and arrived at the laboratory at the appropriate temperatures of between two and six degrees Celsius, with the exceptions noted below.

SDG 1408-153: The sample cooler temperature recorded at the laboratory was ten degrees Celsius. The positive results and reporting limits for all target analytes were qualified as estimated (J/UJ) in Samples PZ-719-140818, PZ-723-140818, DUPE-3-140818, PZ-726-140818, PZ-728-140818, RPZ-730-140818, and TB-Team3-140818.

SDG 1408-185: The sample cooler temperature recorded at the laboratory was sixteen degrees Celsius. The positive results and reporting limits for all target analytes were qualified as estimated (J/UJ) in Samples MW-100-140820, MW-ES-07-140820, MW-UI-140820, RB-3-140820, and TB-3-140820.

SDG 1408-202: The sample cooler temperature recorded at the laboratory was twelve degrees Celsius. The positive results and reporting limits for all target analytes were qualified as estimated (J/UJ) in Samples MW-101A-140821, DUPE-3-140821, MW-101B-140821, MW-109-140821, RB-3-140821, and TB-3-140821.

SDG 1408-215: The sample cooler temperature recorded at the laboratory was eight degrees Celsius. The positive results and reporting limits for all target analytes were qualified as estimated (J/UJ) in

Samples MW-102-140822, MW-103-140822, MW-111-140822, DUPE-3-140822, RB-3-140822, and TB-3-140822.

SDG 1408-227: The sample cooler temperature recorded at the laboratory was nine degrees Celsius. The positive results and reporting limits for all target analytes were qualified as estimated (J/UJ) in Samples MW-ES-11-140825, WDOT-MW-1-140825, WDOT-MW2-140825, RB-3-140825, and TB-2-140825.

SDG 1408-251: The sample cooler temperature recorded at the laboratory was one degree Celsius. It was determined through professional judgment that since the samples were not frozen, this temperature should not affect the sample analytical results.

Surrogate Recoveries

A surrogate compound is a compound that is chemically similar to the organic analytes of interest, but unlikely to be found in any environmental sample. Surrogates are used for organic analyses and are added to all samples, standards, and blanks to serve as an accuracy and specificity check of each analysis. The surrogates are added to the samples at a known concentration and percent recoveries are calculated following analysis. All surrogate percent recoveries for field samples were within the laboratory control limits.

Method, Trip, and Rinsate Blanks

Method blanks are analyzed to ensure that laboratory procedures and reagents do not introduce measurable concentrations of the analytes of interest. A method blank was analyzed with each batch of samples, at a frequency of 1 per 20 samples. For all sample batches, method blanks were analyzed at the required frequency. None of the analytes of interest were detected above the reporting limits in any of the method blanks.

Trip blanks are analyzed to provide an indication as to whether volatile compounds have cross-contaminated other like samples within the transportation process to the laboratory. Twelve (12) trip blanks were collected (one for each cooler): TB-Team3-140818, TB-3-140819, TB-3-140820, TB-3-140821, TB-3-140822, TB-2-140825, TB-3-140825, TB-2-140826, TB-2-140827, TB-1-140827, TB-1-140828, and TB-2-140828. None of the analytes of interest were detected above the reporting limits in any of the trip blanks.

Equipment rinsate blanks are analyzed to provide an indication as to whether field decontamination and sampling procedures effectively prevent cross-contamination in field activities. Nine (9) equipment rinsate blanks were collected: RB-3-140820, RB-3-140821, RB-3-140822, RB-3-140825, RB-2-140826, RB-1-140827, RB-2-140827, RB-1-140828, and RB-2-140828. None of the analytes of interest were detected above the reporting limits in any of the rinsate blanks.

Matrix Spikes/Matrix Spike Duplicates

Since the actual analyte concentration in an environmental sample is not known, the accuracy of a particular analysis is usually inferred by performing a matrix spike (MS) analysis on one sample from the associated batch, known as the parent sample. One aliquot of the sample is analyzed in the normal manner and then a second aliquot of the sample is spiked with a known amount of analyte concentration and analyzed. From these analyses, a percent recovery is calculated. Matrix spike duplicate (MSD) analyses are generally performed for organic analyses as a precision check and analyzed in the same sequence as a matrix spike. Using the result values from the MS and MSD, the relative percent difference (RPD) is calculated. The percent recovery control limits for MS and MSD analyses are specified in the laboratory documents, as are the RPD control limits for MS/MSD sample sets.

One MS/MSD analysis should be performed for every analytical batch or every 20 field samples, whichever is more frequent. The frequency requirements were met for all analyses and the percent recovery and RPD values were within the proper control limits.

Laboratory Control Samples/Laboratory Control Sample Duplicates

A laboratory control sample (LCS) is a blank sample that is spiked with a known amount of analyte and then analyzed. An LCS is similar to an MS, but without the possibility of matrix interference. Given that matrix interference is not an issue, the LCS/LCSD control limits for accuracy and precision are usually more rigorous than for MS/MSD analyses. Additionally, data qualification based on LCS/LCSD analyses would apply to all samples in the associated batch, instead of just the parent sample. The percent recovery control limits for LCS and LCSD analyses are specified in the laboratory documents, as are the RPD control limits for LCS/LCSD sample sets.

One LCS/LCSD analysis should be performed for every analytical batch or every 20 field samples, whichever is more frequent. The frequency requirements were met for all analyses and the percent recovery and RPD values were within the proper control limits.

Field Duplicates

In order to assess precision, field duplicate samples are collected and analyzed along with the reviewed sample batches. The duplicate samples are analyzed for the same parameters as the associated parent samples. Precision is determined by calculating the RPD between each pair of samples. If one or more of the sample analytes has a concentration greater than five times the reporting limit for that sample, then the absolute difference is used instead of the RPD. The RPD control limit for water samples is 20 percent.

SDG 1408-153: One field duplicate sample pair, PZ-723-140818 and DUPE-3-140818, was submitted with this SDG. The precision criteria for all volatile target analytes were met for this sample pair.

SDG 1408-202: One field duplicate sample pair, MW-101A-140821 and DUPE-3-140821, was submitted with this SDG. The precision criteria for all volatile target analytes were met for this sample pair.

SDG 1408-215: One field duplicate sample pair, MW-111-140822 and DUPE-3-140822, was submitted with this SDG. The precision criteria for all volatile target analytes were met for this sample pair.

SDG 1408-252: One field duplicate sample pair, MW-ES-03-140827 and DUP-1-140827, was submitted with this SDG. The precision criteria for all volatile target analytes were met for this sample pair.

One FD shall be collected and analyzed for every 20 field samples, or one per sampling event (whichever is greater), to verify the precision of laboratory and/or sampling methodology. The frequency requirements were met for all analyses.

Internal Standards (Low Resolution Mass Spectrometry)

Like the surrogate, an internal standard is a compound that is chemically similar to the analytes of interest, but unlikely to be found in any environmental sample. Internal standards are used only for the mass spectrometry instrumentation and are usually added to the sample aliquot after extraction has taken place. The internal standard should be analyzed at the beginning of a 12 hour sample run and the control limits for internal standard recoveries are 50 percent to 200 percent of the calibration standard. All internal standard recoveries were within the control limits.

Initial Calibrations (ICALs)

All initial calibrations were conducted according to the laboratory methods and consisted of the appropriate number of standards. All percent relative standard deviation (%RSD) values were less than +/- 30 percent and all relative response factors (RRF) were greater than 0.05.

Continuing Calibrations (CCALs)

All continuing calibrations were conducted according to the laboratory methods and consisted of the appropriate number of standards. All percent difference (%D) values were less than +/- 25 percent and all relative response factors (RRF) were greater than 0.05.

Reporting Limits

The contract required quantitation limits (CRQL) were met by the laboratory for all target analytes throughout this sampling event.

OVERALL ASSESSMENT

As was determined by this data validation, the laboratory followed the specified analytical methods. Accuracy was acceptable, as demonstrated by the surrogate, LCS/LCSD, and MS/MSD percent recovery values. Precision was acceptable, as demonstrated by the LCS/LCSD, MS/MSD, and field duplicate RPD values.

All data are acceptable for the intended use, with the following qualifications listed below in Table 2.

TABLE 2: SUMMARY OF QUALIFIED SAMPLES

Sample ID	Analyte					
	1,1-DCE	cis-1,2-DCE	PCE	trans-1,2-DCE	TCE	Vinyl Chloride
DUPE-3-140818	UJ	UJ	UJ	UJ	UJ	UJ
DUPE-3-140821	UJ	UJ	UJ	UJ	UJ	UJ
DUPE-3-140822	UJ	UJ	UJ	UJ	J	UJ
MW-100-140820	UJ	UJ	UJ	UJ	UJ	UJ
MW-101A-140821	UJ	UJ	UJ	UJ	UJ	UJ
MW-101B-140821	UJ	UJ	UJ	UJ	J	UJ
MW-102-140822	UJ	UJ	UJ	UJ	UJ	UJ
MW-103-140822	UJ	UJ	UJ	UJ	UJ	UJ
MW-109-140821	UJ	UJ	UJ	UJ	J	UJ
MW-111-140822	UJ	UJ	UJ	UJ	J	UJ
MW-ES-07-140820	UJ	UJ	UJ	UJ	J	UJ
MW-ES-11-140825	UJ	UJ	UJ	UJ	J	UJ
MW-UI-140820	UJ	J	UJ	UJ	J	UJ
PZ-719-140818	UJ	UJ	UJ	UJ	J	UJ
PZ-723-140818	UJ	UJ	UJ	UJ	UJ	UJ
PZ-726-140818	UJ	UJ	UJ	UJ	J	UJ
PZ-728-140818	UJ	UJ	UJ	UJ	J	UJ
RB-3-140820	UJ	UJ	UJ	UJ	UJ	UJ
RB-3-140821	UJ	UJ	UJ	UJ	UJ	UJ
RB-3-140822	UJ	UJ	UJ	UJ	UJ	UJ
RB-3-140825	UJ	UJ	UJ	UJ	UJ	UJ
RPZ-730-140818	UJ	UJ	UJ	UJ	UJ	UJ
TB-2-140825	UJ	UJ	UJ	UJ	UJ	UJ

Sample ID	Analyte					
	1,1-DCE	cis-1,2-DCE	PCE	trans-1,2-DCE	TCE	Vinyl Chloride
TB-Team3-140818	UJ	UJ	UJ	UJ	UJ	UJ
TB-3-140820	UJ	UJ	UJ	UJ	UJ	UJ
TB-3-140821	UJ	UJ	UJ	UJ	UJ	UJ
TB-3-140822	UJ	UJ	UJ	UJ	UJ	UJ
WDOT-MW-1-140825	UJ	UJ	UJ	UJ	UJ	UJ
WDOT-MW2-140825	UJ	UJ	UJ	UJ	UJ	UJ

1,1-DCE - 1,1-Dichloroethene

cis-1,2-DCE - cis-1,2-Dichloroethene

PCE – Tetrachloroethene

trans-1,2-DCE - trans-1,2-Dichloroethene

TCE – Trichloroethene

REFERENCES

U.S. Environmental Protection Agency (USEPA). "Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use," EPA-540-R-08-005. January 2009.

U.S. Environmental Protection Agency (USEPA). "Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review," EPA-540-R-08-01. June 2008.

GeoEngineers, Inc., "Field Sampling Plan, Semiannual Groundwater Monitoring," prepared for Washington State Department of Transportation. February 15, 2013.

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Data Validation Report

Project: Palermo Wellfield Remedial Investigation and Feasibility Study
August 2014 Subdrain System and Treatment Lagoon Sampling

GEI File No: 00180-121-09

Date: September 11, 2014

This report documents the results of a United States Environmental Protection Agency (USEPA)-defined Stage 2B data validation (USEPA Document 540-R-08-005; USEPA, 2009) of analytical data from the analyses of water samples collected as part of the August 2014 Subdrain System and Treatment Lagoon sampling event, and the associated laboratory and field quality control (QC) samples. The samples were obtained from the Palermo Wellfield Superfund Site located in Tumwater, Washington.

OBJECTIVE AND QUALITY CONTROL ELEMENTS

GeoEngineers, Inc. (GeoEngineers) completed the data validation consistent with USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review (USEPA, 2008) (National Functional Guidelines) to determine if the laboratory analytical results meet the project objectives and are usable for their intended purpose. Data usability was assessed by determining if:

- The samples were analyzed using well-defined and acceptable methods that provide reporting limits below applicable regulatory criteria;
- The precision and accuracy of the data are well-defined and sufficient to provide defensible data; and
- The quality assurance/quality control (QA/QC) procedures utilized by the laboratory meet acceptable industry practices and standards.

In accordance with the Quality Assurance Project Plan (GeoEngineers, 2013), the data validation included review of the following QC elements:

- Data Package Completeness
- Chain-of-Custody Documentation
- Holding Times and Sample Preservation
- Surrogate Recoveries
- Method, Trip, and Rinsate Blanks
- Matrix Spikes/Matrix Spike Duplicates
- Laboratory Control Samples/Laboratory Control Sample Duplicates
- Field Duplicates (FDs)
- Internal Standards
- Initial Calibrations (ICALs)
- Continuing Calibrations (CCALs)
- Reporting Limits

VALIDATED SAMPLE DELIVERY GROUPS

This data validation included review of the sample delivery group (SDG) listed below in Table 1.

TABLE 1: SUMMARY OF VALIDATED SAMPLE DELIVERY GROUPS

Laboratory SDG	Samples Validated
1408-240	350-140826, 356-140826, 357-140826, 358-140826, DUP-1-140826, 359-140826, 360-140826, 361-140826, 364-140826, RB-1-140826, TB-1-140826

CHEMICAL ANALYSIS PERFORMED

OnSite Environmental, Inc. (OnSite), located in Redmond, Washington, performed laboratory analysis on the water samples using the following method:

- Volatile Organic Compounds (VOCs) by Method SW8260C

DATA VALIDATION SUMMARY

The results for each of the QC elements are summarized below.

Data Package Completeness

OnSite provided all required deliverables for the data validation according to the National Functional Guidelines. The laboratory followed adequate corrective action processes and all identified anomalies were discussed in the relevant laboratory case narrative.

Chain-of-Custody Documentation

Chain-of-custody (COC) forms were provided with the laboratory analytical reports. The COCs were accurate and complete when submitted to the lab. The following was noted on the sample receipt form:

SDG 1408-240: The laboratory noted for Samples 356-140826 and 360-140826, one of the three vials received contained a bubble. For these samples, sample analyses were performed on a vial that did not contain a bubble.

Holding Times and Sample Preservation

The sample holding time is defined as the time that elapses between sample collection and sample analysis. Maximum holding time criteria exist for each analysis to help ensure that the analyte concentrations found at the time of analysis reflect the concentration present at the time of sample collection. Established holding times were met for all analyses. The samples within all cooler containers were properly protected with bubble wrap, preserved with wet ice and arrived at the laboratory at the appropriate temperature of between two and six degrees Celsius.

Surrogate Recoveries

A surrogate compound is a compound that is chemically similar to the organic analytes of interest, but unlikely to be found in any environmental sample. Surrogates are used for organic analyses and are added to all samples, standards, and blanks to serve as an accuracy and specificity check of each analysis. The surrogates are added to the samples at a known concentration and percent recoveries are calculated following analysis. All surrogate percent recoveries for field samples were within the laboratory control limits.

Method, Trip, and Rinsate Blanks

Method blanks are analyzed to ensure that laboratory procedures and reagents do not introduce measurable concentrations of the analytes of interest. A method blank was analyzed with each batch of samples, at a frequency of 1 per 20 samples. For all sample batches, method blanks were analyzed at the required frequency. None of the analytes of interest were detected above the reporting limits in any of the method blanks.

Trip blanks are analyzed to provide an indication as to whether volatile compounds have cross-contaminated other like samples within the transportation process to the laboratory. One (1) trip blank, TB-1-140826, was collected. None of the analytes of interest were detected above the reporting limits in the trip blank.

Equipment rinsate blanks are analyzed to provide an indication as to whether field decontamination and sampling procedures effectively prevent cross-contamination in field activities. One (1) equipment rinsate blank, RB-1-140826, was collected. None of the analytes of interest were detected above the reporting limits in the rinsate blank.

Matrix Spikes/Matrix Spike Duplicates

Since the actual analyte concentration in an environmental sample is not known, the accuracy of a particular analysis is usually inferred by performing a matrix spike (MS) analysis on one sample from the associated batch, known as the parent sample. One aliquot of the sample is analyzed in the normal manner and then a second aliquot of the sample is spiked with a known amount of analyte concentration and analyzed. From these analyses, a percent recovery is calculated. Matrix spike duplicate (MSD) analyses are generally performed for organic analyses as a precision check and analyzed in the same sequence as a matrix spike. Using the result values from the MS and MSD, the relative percent difference (RPD) is calculated. The percent recovery control limits for MS and MSD analyses are specified in the laboratory documents, as are the RPD control limits for MS/MSD sample sets.

One MS/MSD analysis should be performed for every analytical batch or every 20 field samples, whichever is more frequent. The frequency requirements were met for all analyses and the percent recovery and RPD values were within the proper control limits.

Laboratory Control Samples/Laboratory Control Sample Duplicates

A laboratory control sample (LCS) is a blank sample that is spiked with a known amount of analyte and then analyzed. An LCS is similar to an MS, but without the possibility of matrix interference. Given that matrix interference is not an issue, the LCS/LCSD control limits for accuracy and precision are usually more rigorous than for MS/MSD analyses. Additionally, data qualification based on LCS/LCSD analyses would apply to all samples in the associated batch, instead of just the parent sample. The percent recovery control limits for LCS and LCSD analyses are specified in the laboratory documents, as are the RPD control limits for LCS/LCSD sample sets.

An MS/MSD analysis was performed on Sample 364-140826; therefore, the LCS analysis was not reported.

Field Duplicates

In order to assess precision, field duplicate samples are collected and analyzed along with the reviewed sample batches. The duplicate samples are analyzed for the same parameters as the associated parent samples. Precision is determined by calculating the RPD between each pair of samples. If one or more of the sample analytes has a concentration greater than five times the reporting limit for that sample, then the absolute difference is used instead of the RPD. The RPD control limit for water samples is 20 percent.

SDG 1408-240: One field duplicate sample pair, 358-140826 and DUP-1-140826, was submitted with this SDG. The precision criteria for all volatile target analytes were met for this sample pair.

One FD shall be collected and analyzed for every 20 field samples, or one per sampling event (whichever is greater), to verify the precision of laboratory and/or sampling methodology. The frequency requirements were met for all analyses.

Internal Standards (Low Resolution Mass Spectrometry)

Like the surrogate, an internal standard is a compound that is chemically similar to the analytes of interest, but unlikely to be found in any environmental sample. Internal standards are used only for the mass spectrometry instrumentation and are usually added to the sample aliquot after extraction has taken place. The internal standard should be analyzed at the beginning of a 12 hour sample run and the control limits for internal standard recoveries are 50 percent to 200 percent of the calibration standard. All internal standard recoveries were within the control limits.

Initial Calibrations (ICALs)

All initial calibrations were conducted according to the laboratory methods and consisted of the appropriate number of standards. All percent relative standard deviation (%RSD) values were less than +/- 30 percent and all relative response factors (RRF) were greater than 0.05.

Continuing Calibrations (CCALs)

All continuing calibrations were conducted according to the laboratory methods and consisted of the appropriate number of standards. All percent difference (%D) values were less than +/- 25 percent and all relative response factors (RRF) were greater than 0.05.

Reporting Limits

The contract required quantitation limits (CRQL) were met by the laboratory for all target analytes throughout this sampling event.

OVERALL ASSESSMENT

As was determined by this data validation, the laboratory followed the specified analytical methods. Accuracy was acceptable, as demonstrated by the surrogate and MS/MSD percent recovery values. Precision was acceptable, as demonstrated by the MS/MSD and field duplicate RPD values.

No analytical results were qualified. All data are acceptable for the intended use.

REFERENCES

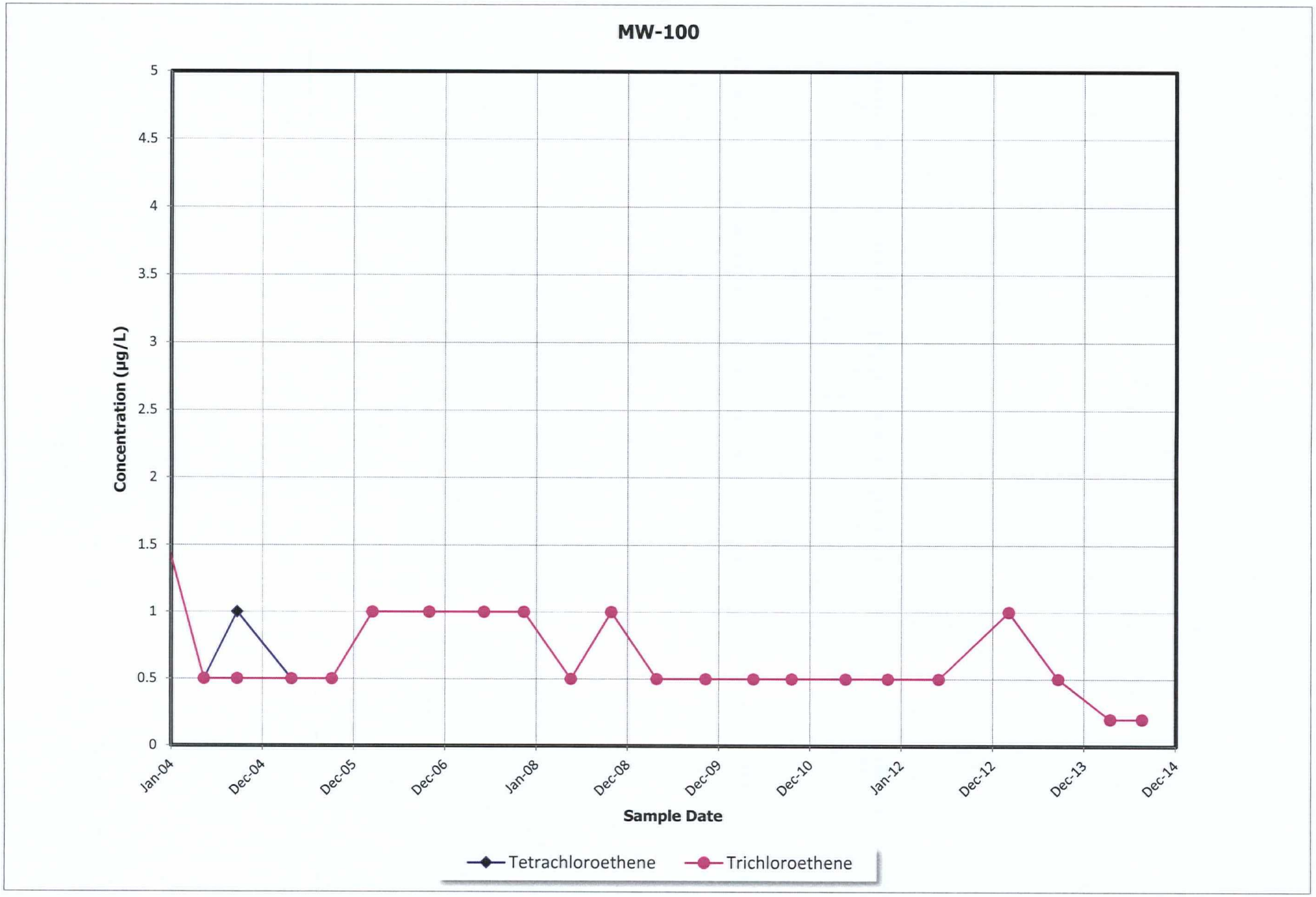
U.S. Environmental Protection Agency (USEPA). "Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use," EPA-540-R-08-005. January 2009.

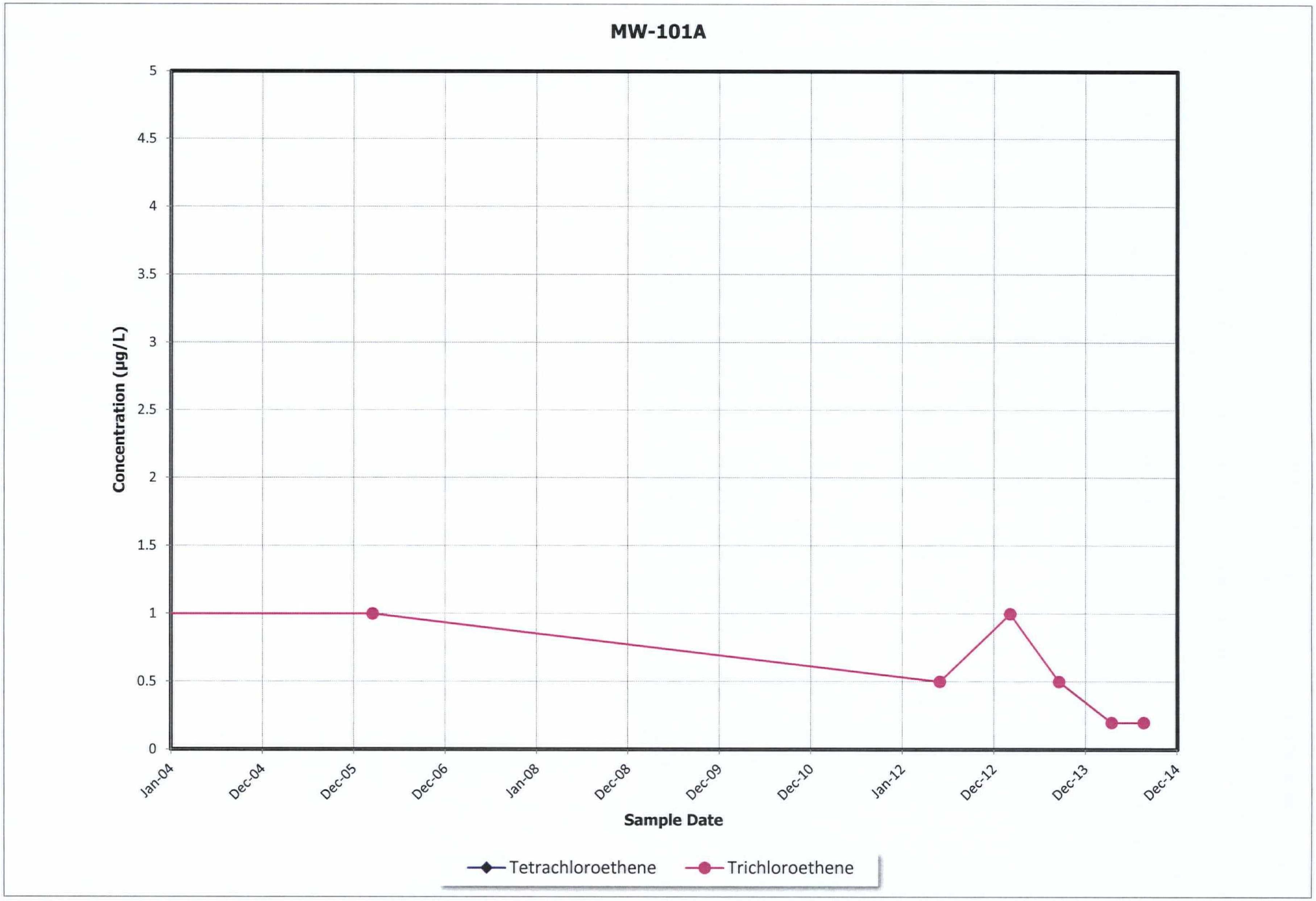
U.S. Environmental Protection Agency (USEPA). "Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review," EPA-540-R-08-01. June 2008.

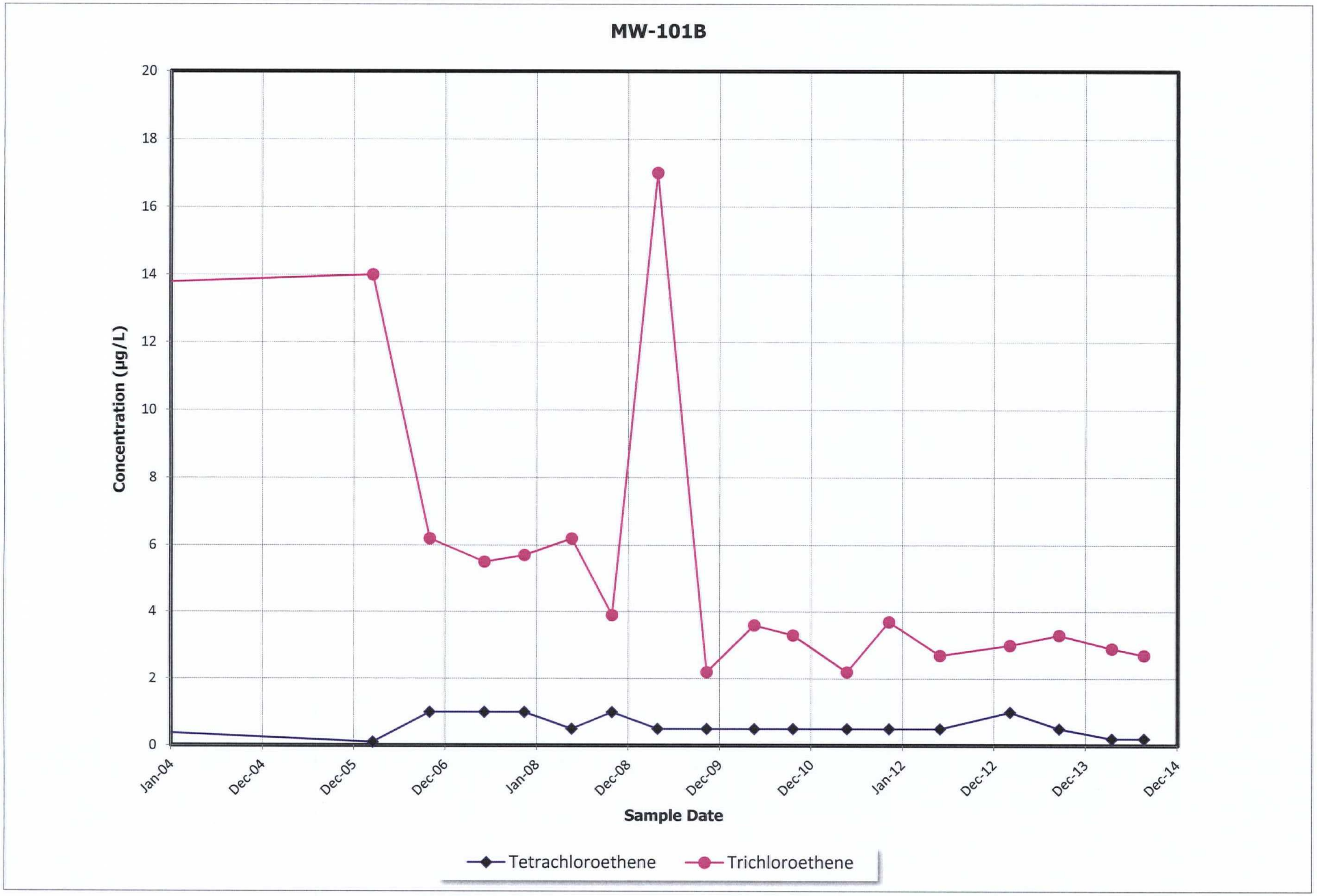
GeoEngineers, Inc., "Quality Assurance Project Plan, Subdrain System and Treatment Lagoon Sampling," prepared for Washington State Department of Transportation. February 15, 2013.

APPENDIX D
Laboratory Analytical Data Reports
(Included on CD)

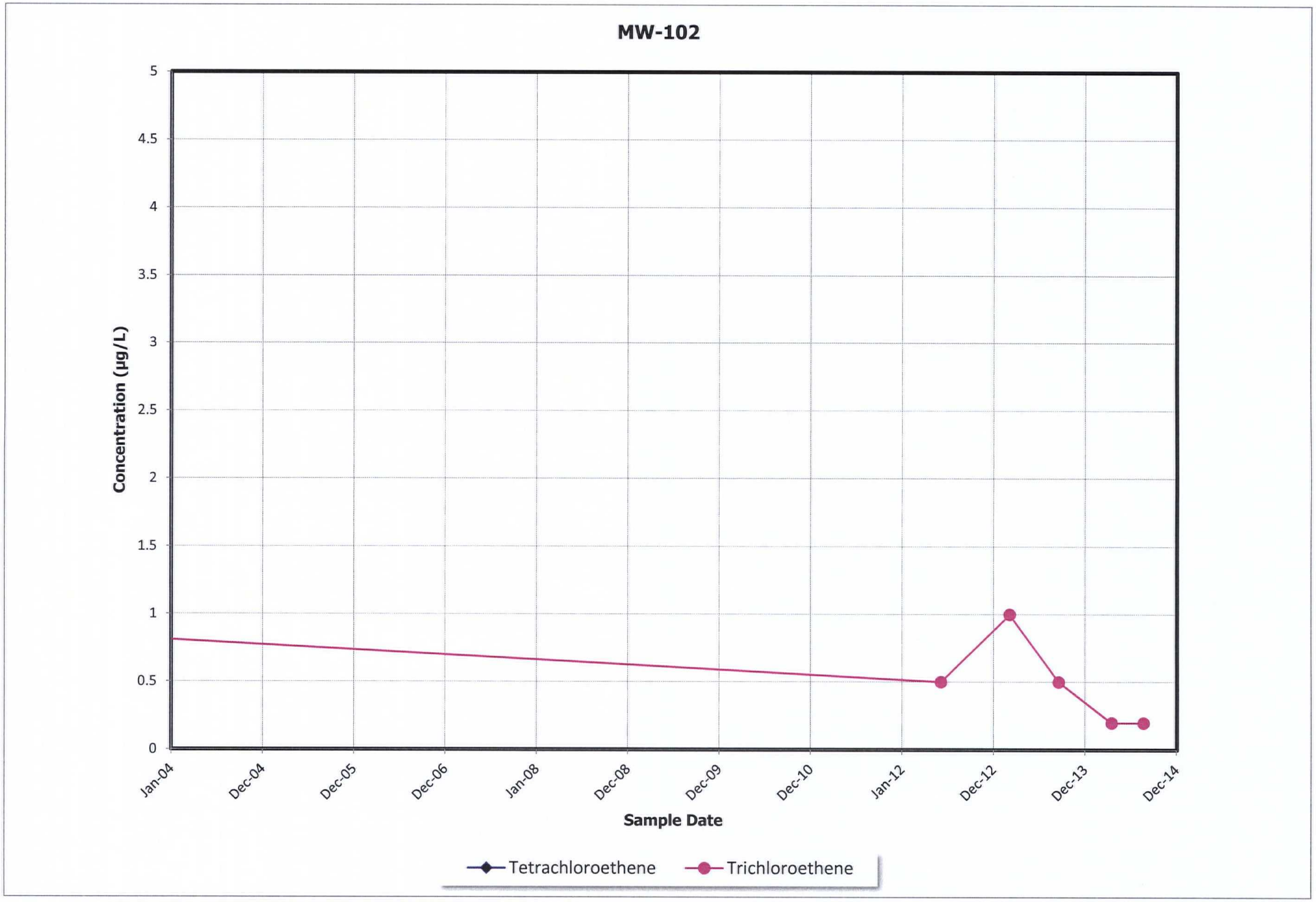
APPENDIX E
Trend Plots


MW-100
Concentration (µg/L)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Jan-04
Dec-04
Dec-05
Dec-06
Jan-08
Dec-08
Dec-09
Dec-10
Jan-12
Dec-12
Dec-13
Dec-14
Sample Date
Tetrachloroethene
Trichloroethene

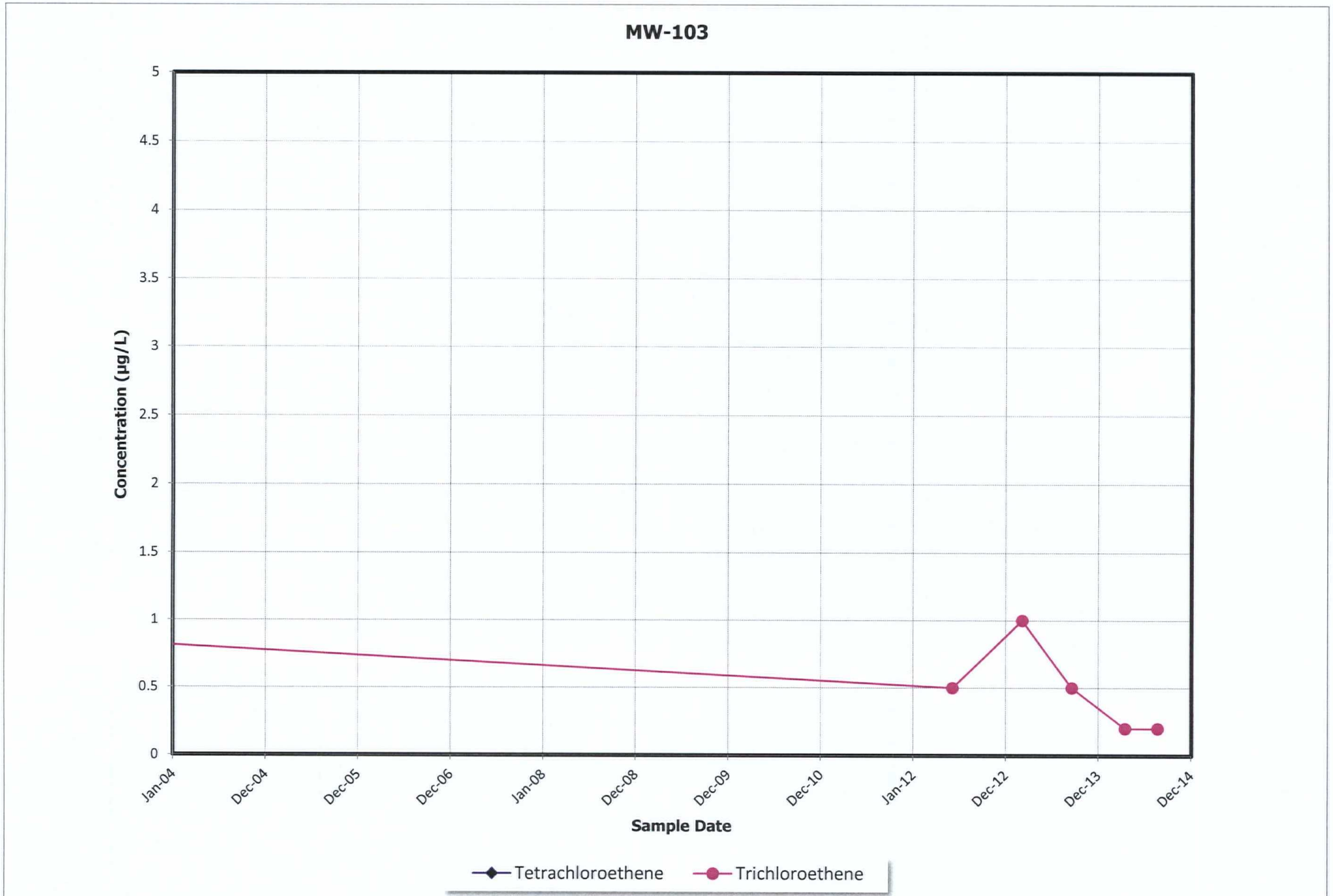

MW-101A
Concentration (µg/L)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Jan-04
Dec-04
Dec-05
Dec-06
Jan-08
Dec-08
Dec-09
Dec-10
Jan-12
Dec-12
Dec-13
Dec-14
Sample Date
Tetrachloroethene
Trichloroethene

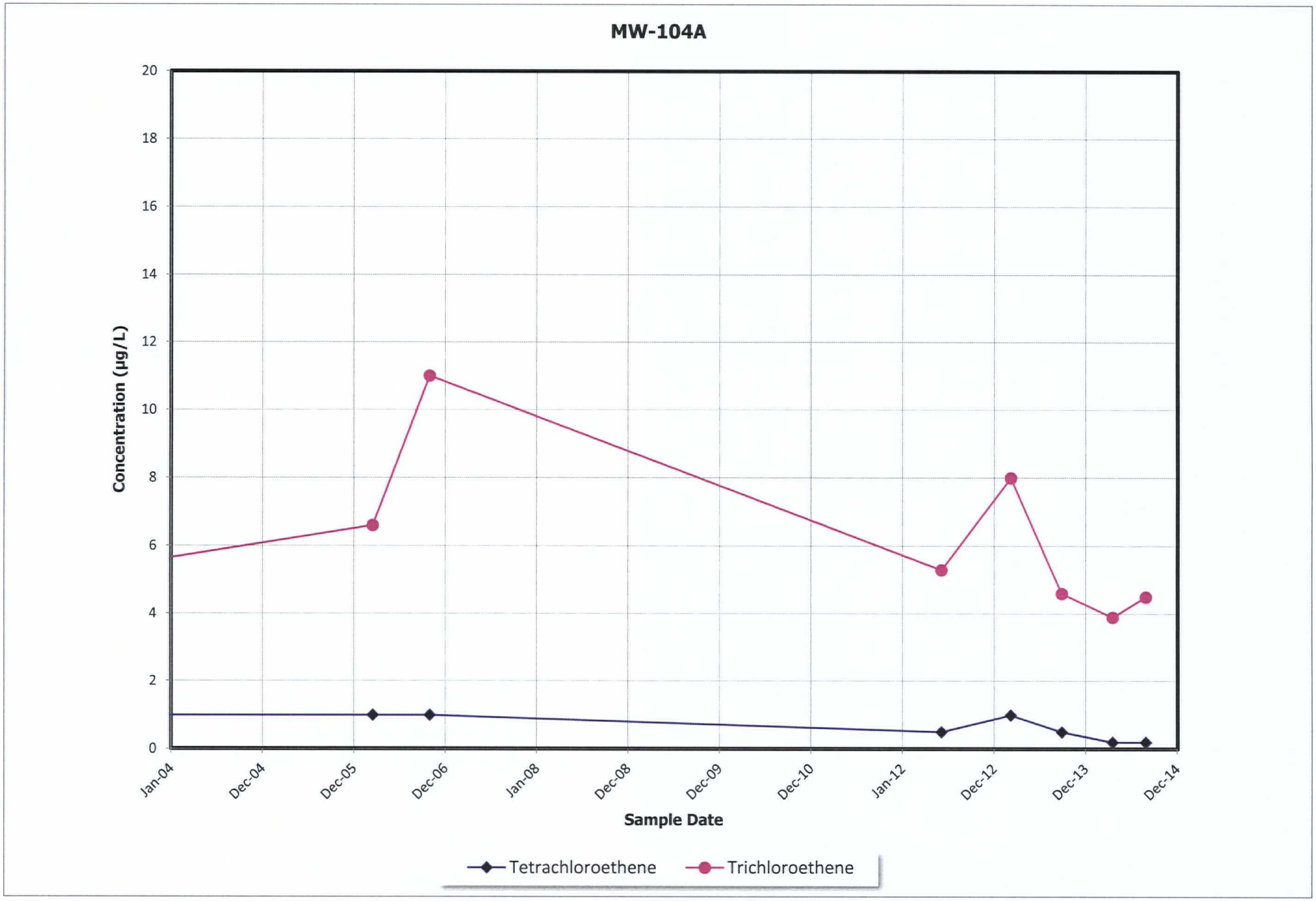

MW-101B
Concentration (µg/L)
20
18
16
14
12
10
8
6
4
2
0
Jan-04
Dec-04
Dec-05
Dec-06
Jan-08
Dec-08
Dec-09
Dec-10
Jan-12
Dec-12
Dec-13
Dec-14
Sample Date
Tetrachloroethene
Trichloroethene

[redacted]

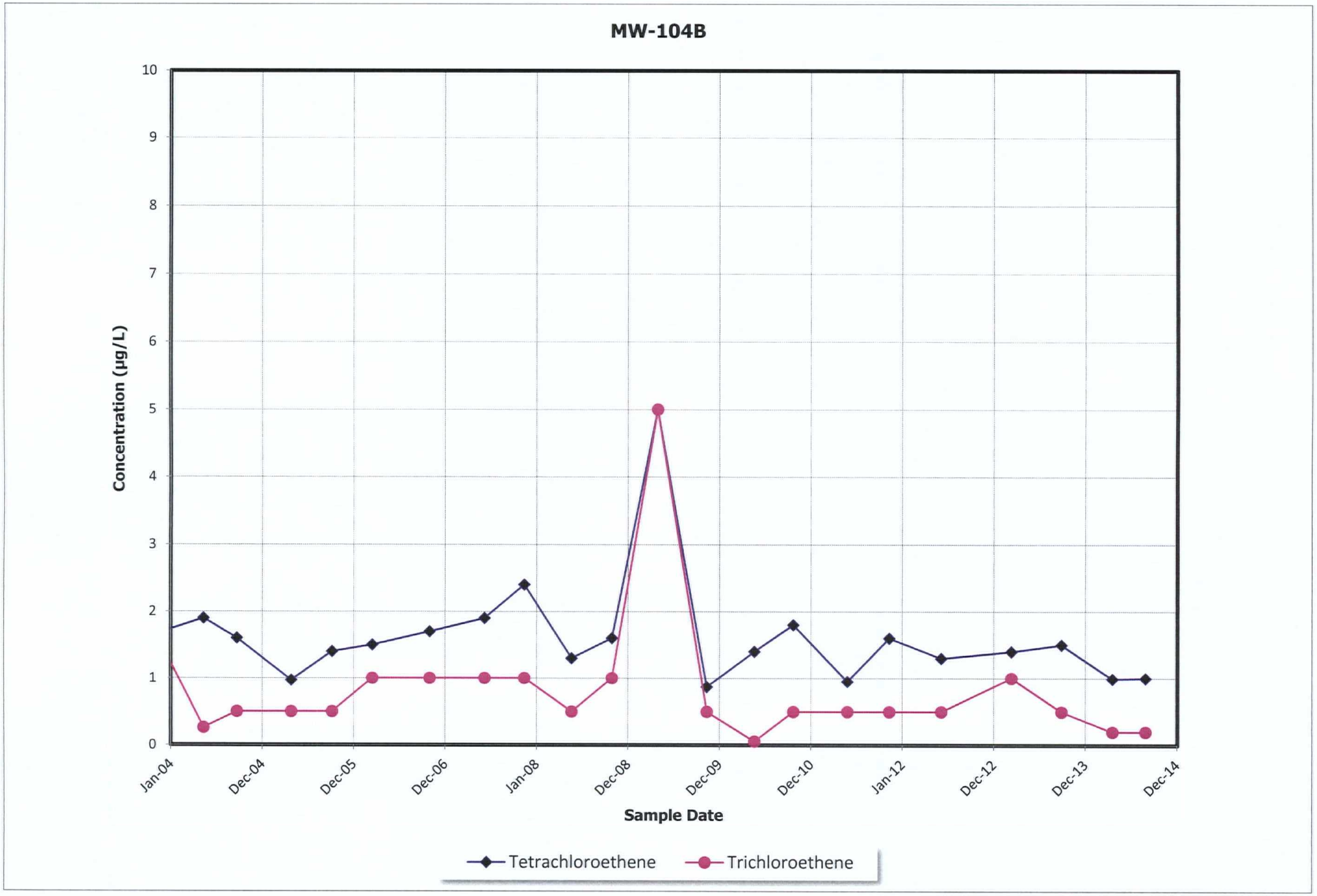


MW-102
Concentration (µg/L)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Jan-04
Dec-04
Dec-05
Dec-06
Jan-08
Dec-08
Dec-09
Dec-10
Jan-12
Dec-12
Dec-13
Dec-14
Sample Date
Tetrachloroethene
Trichloroethene

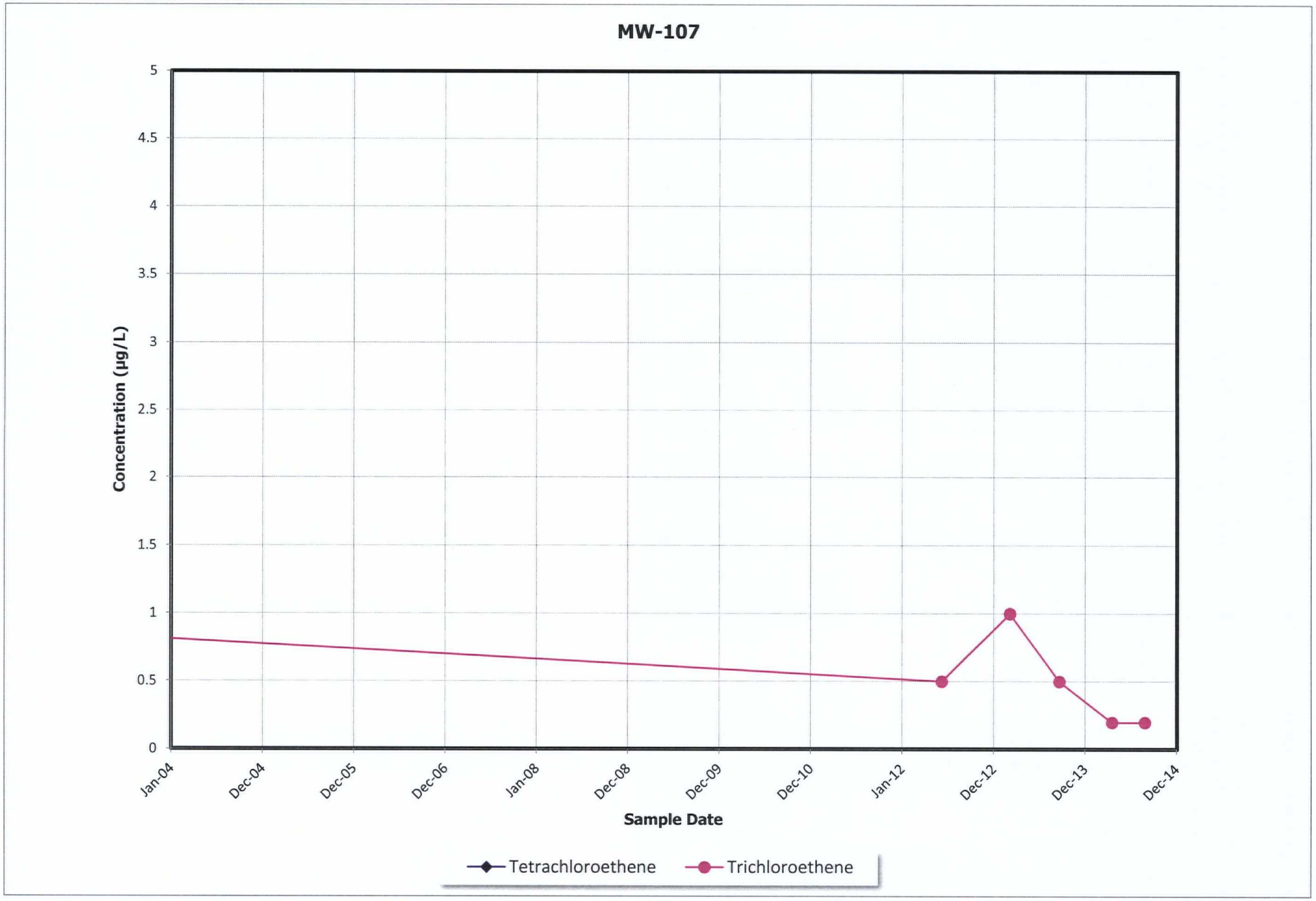

MW-103
Concentration (µg/L)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Jan-04
Dec-04
Dec-05
Dec-06
Jan-08
Dec-08
Dec-09
Dec-10
Jan-12
Dec-12
Dec-13
Dec-14
Sample Date
Tetrachloroethene
Trichloroethene

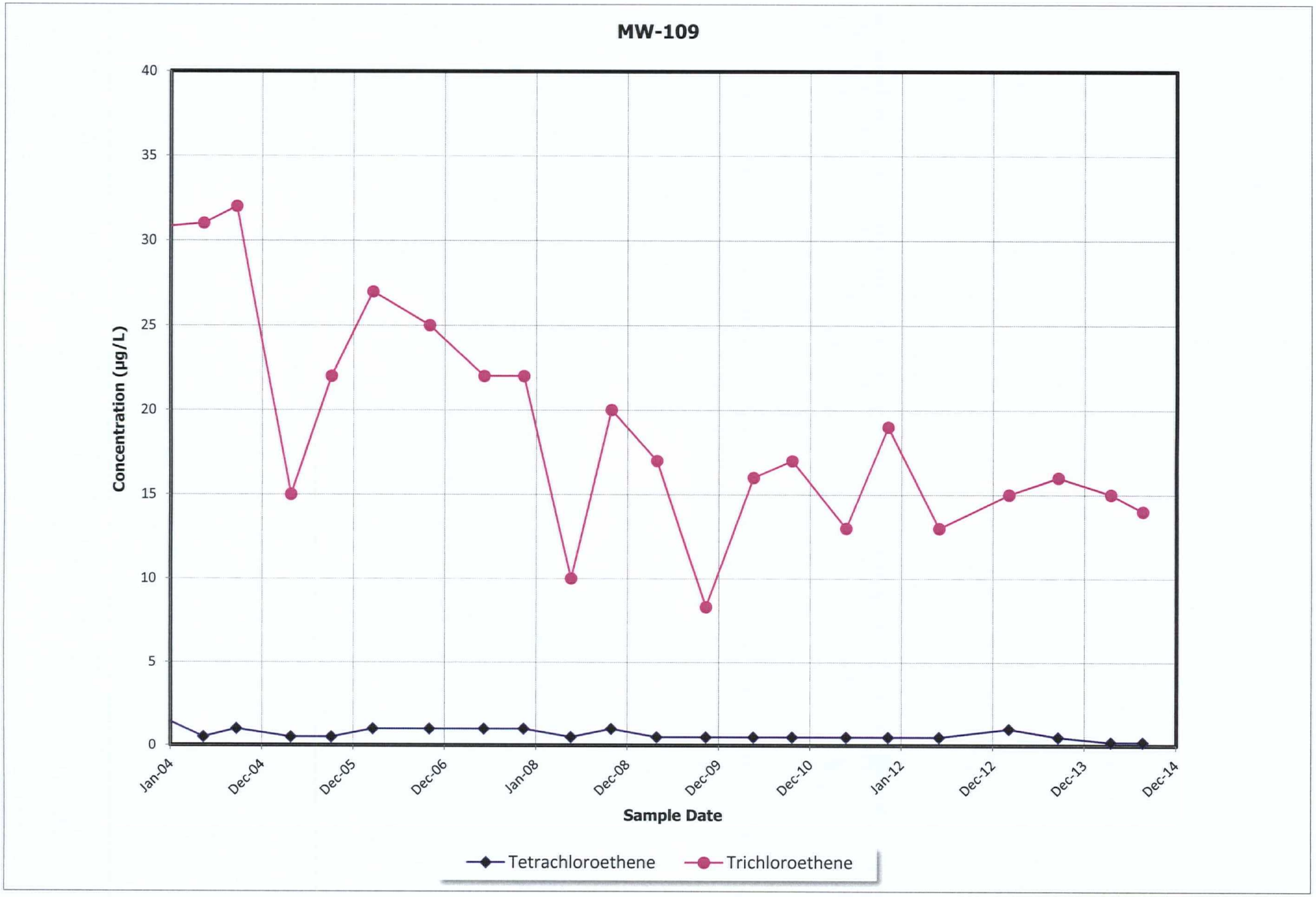


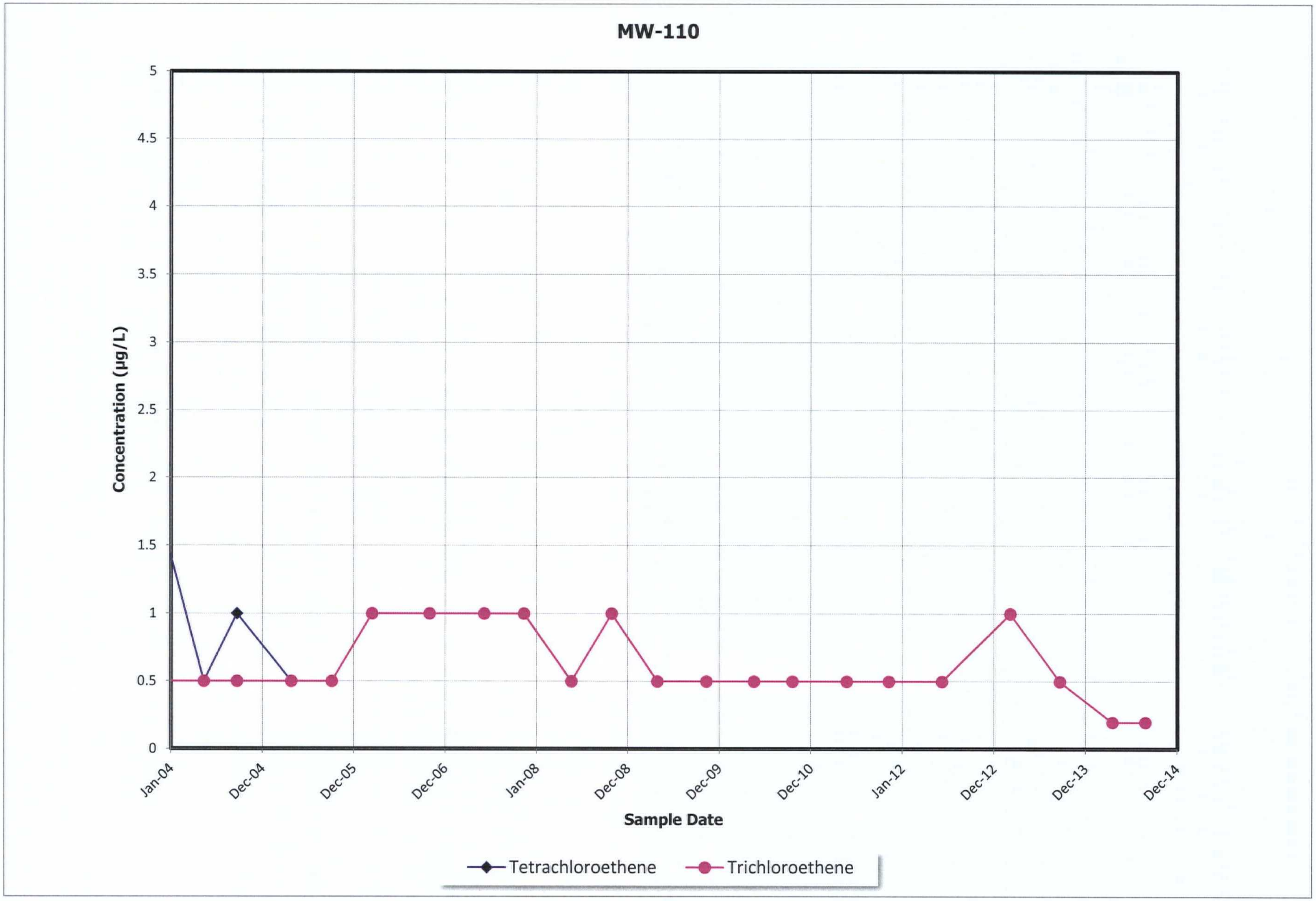
MW-104A
Concentration (µg/L)
20
18
16
14
12
10
8
6
4
2
0
Jan-04
Dec-04
Dec-05
Dec-06
Jan-08
Dec-08
Dec-09
Dec-10
Jan-12
Dec-12
Dec-13
Dec-14
Sample Date
Tetrachloroethene
Trichloroethene

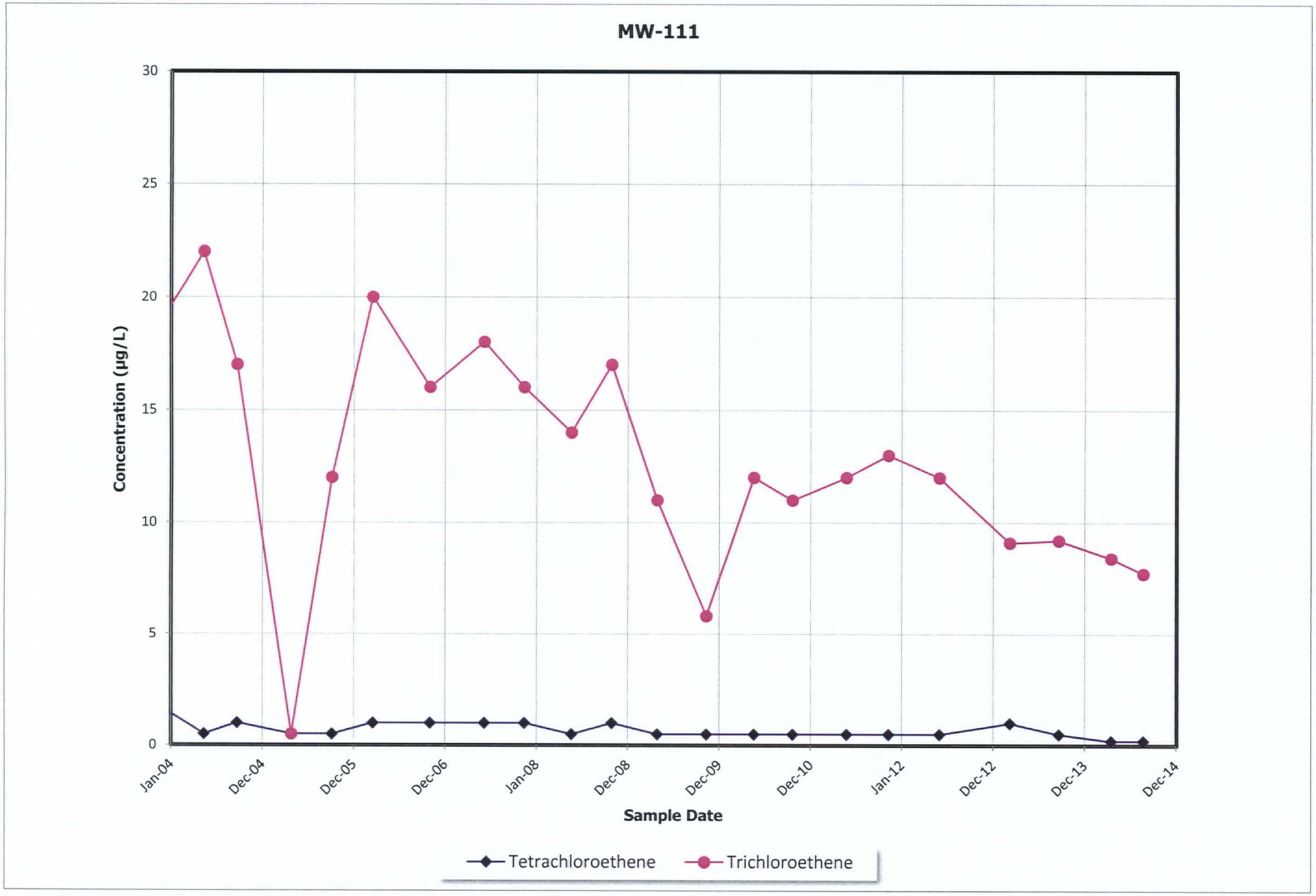


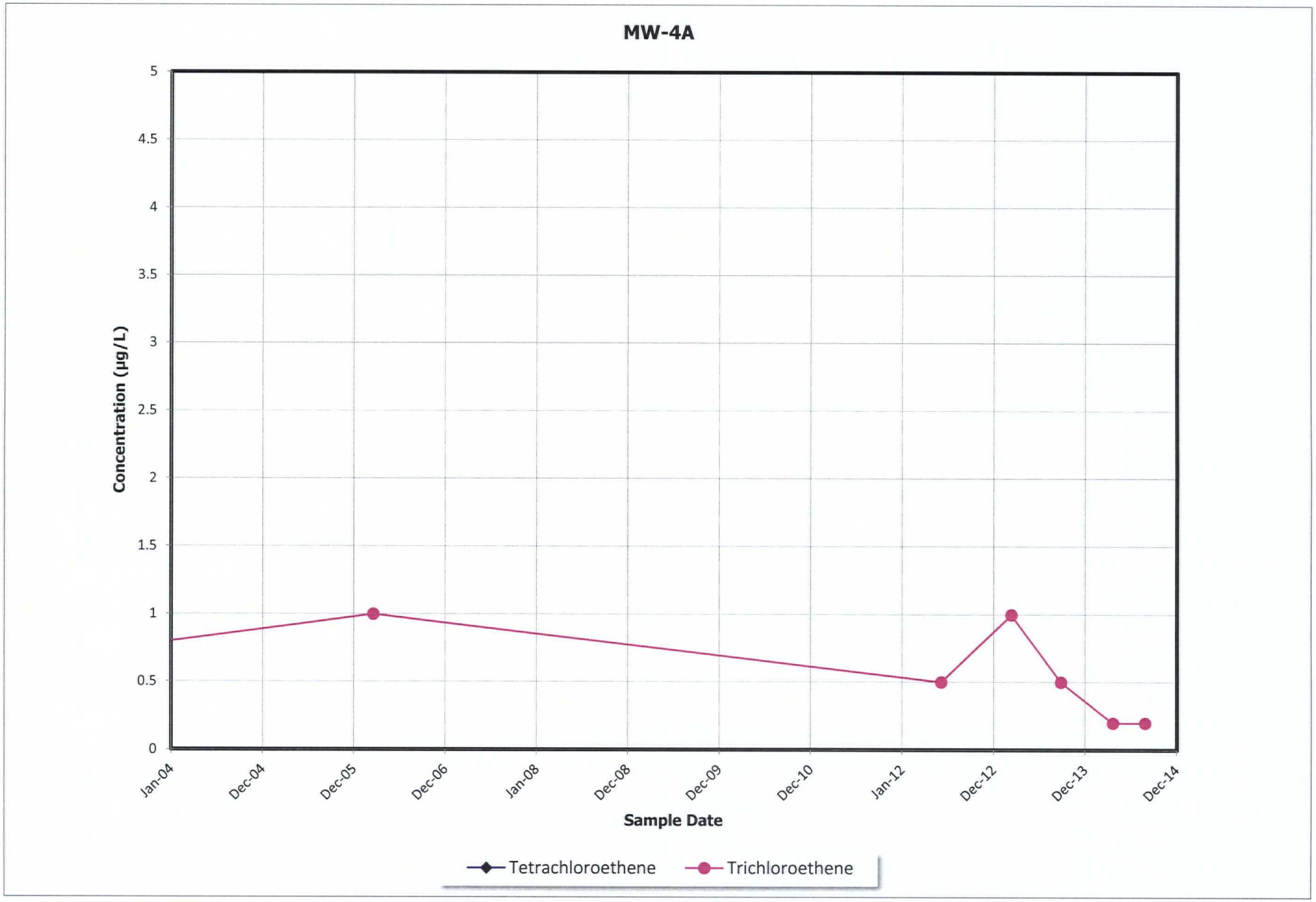
MW-104B
10
9
8
7
6
5
4
3
2
1
0
Concentration (µg/L)
Jan-04
Dec-04
Dec-05
Dec-06
Jan-08
Dec-08
Dec-09
Dec-10
Jan-12
Dec-12
Dec-13
Dec-14
Sample Date
Tetrachloroethene
Trichloroethene

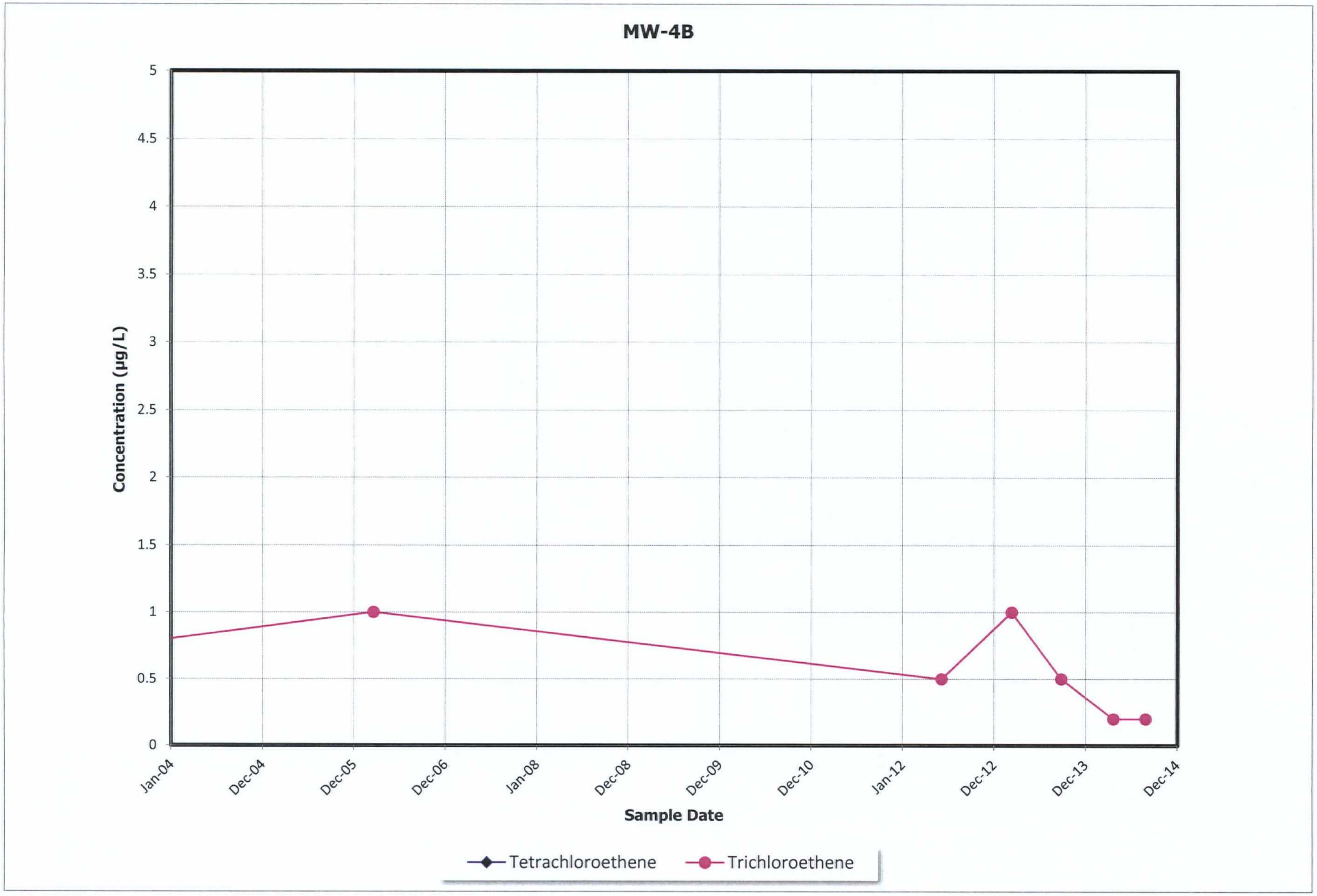

MW-107
Concentration (µg/L)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Jan-04
Dec-04
Dec-05
Dec-06
Jan-08
Dec-08
Dec-09
Dec-10
Jan-12
Dec-12
Dec-13
Dec-14
Sample Date
Tetrachloroethene
Trichloroethene

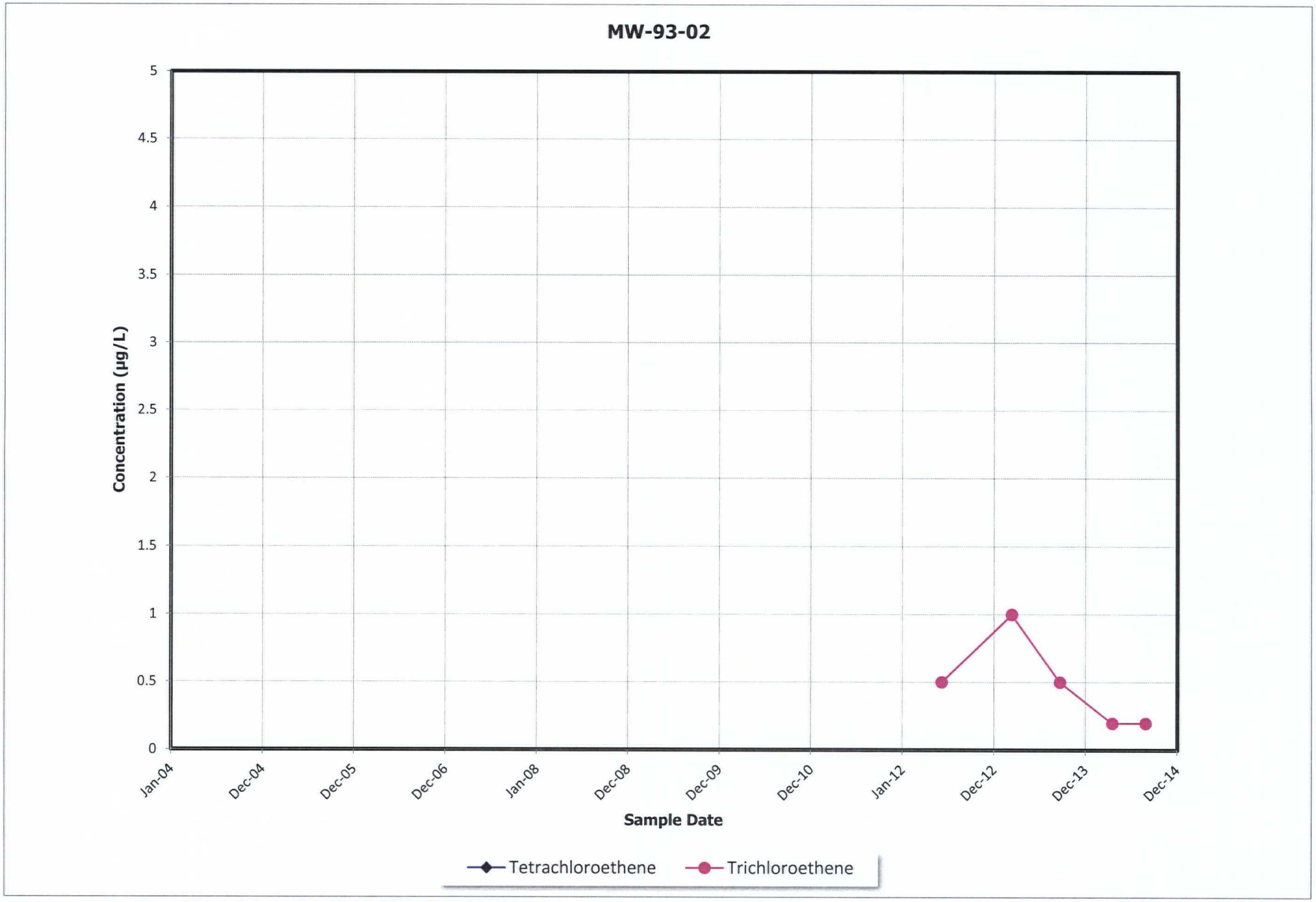

MW-109
Concentration (µg/L)
40
35
30
25
20
15
10
5
0
Jan-04
Dec-04
Dec-05
Dec-06
Jan-08
Dec-08
Dec-09
Dec-10
Jan-12
Dec-12
Dec-13
Dec-14
Sample Date
Tetrachloroethene
Trichloroethene


MW-110
Concentration (µg/L)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
Jan-04
Dec-04
Dec-05
Dec-06
Jan-08
Dec-08
Dec-09
Dec-10
Jan-12
Dec-12
Dec-13
Dec-14
Sample Date
Tetrachloroethene
Trichloroethene

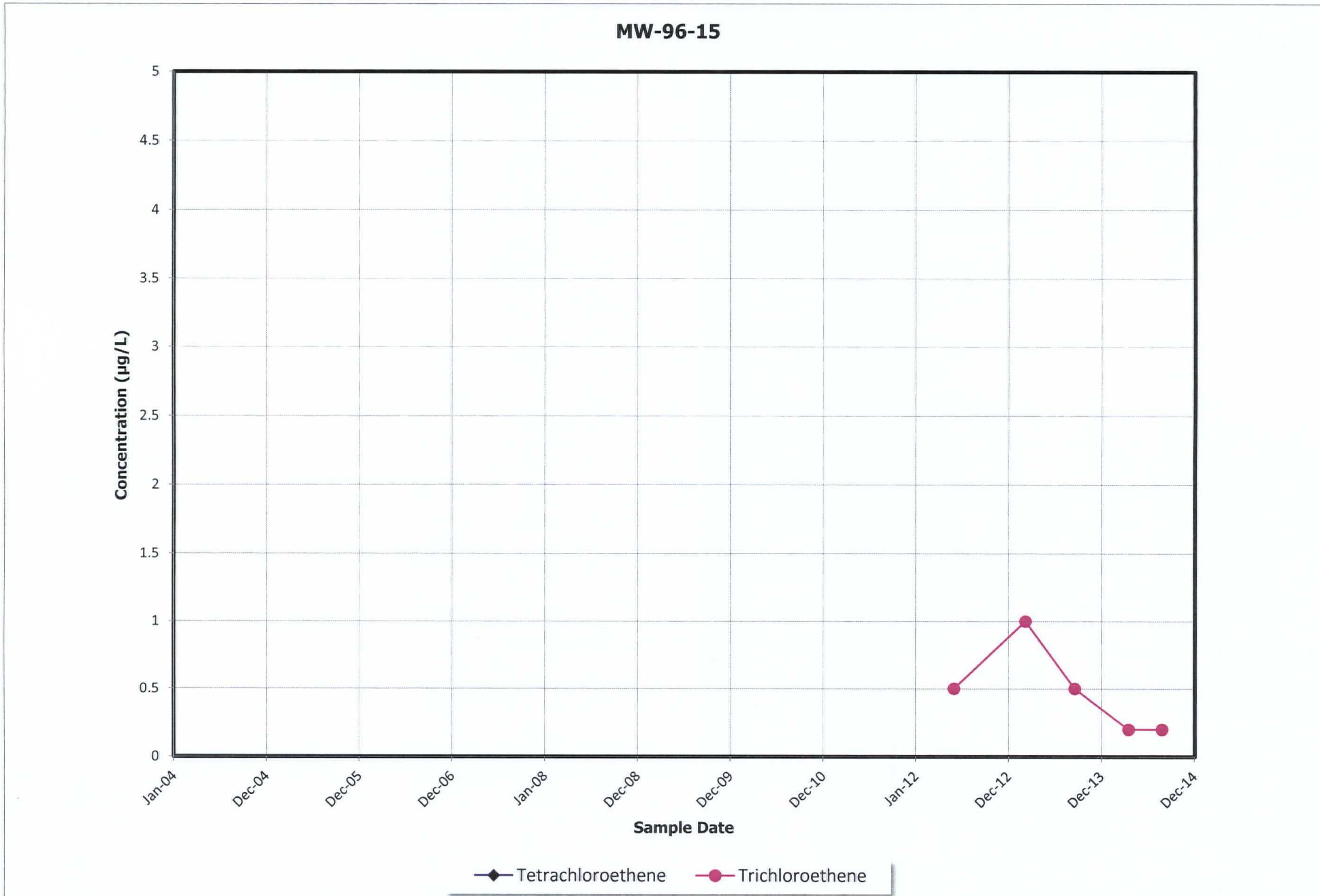

MW-111
Concentration (µg/L)
30
25
20
15
10
5
0
Jan-04
Dec-04
Dec-05
Dec-06
Jan-08
Dec-08
Dec-09
Dec-10
Jan-12
Dec-12
Dec-13
Dec-14
Sample Date
Tetrachloroethene
Trichloroethene


MW-4A
Concentration (µg/L)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
Jan-04
Dec-04
Dec-05
Dec-06
Jan-08
Dec-08
Dec-09
Dec-10
Jan-12
Dec-12
Dec-13
Dec-14
Sample Date
Tetrachloroethene
Trichloroethene

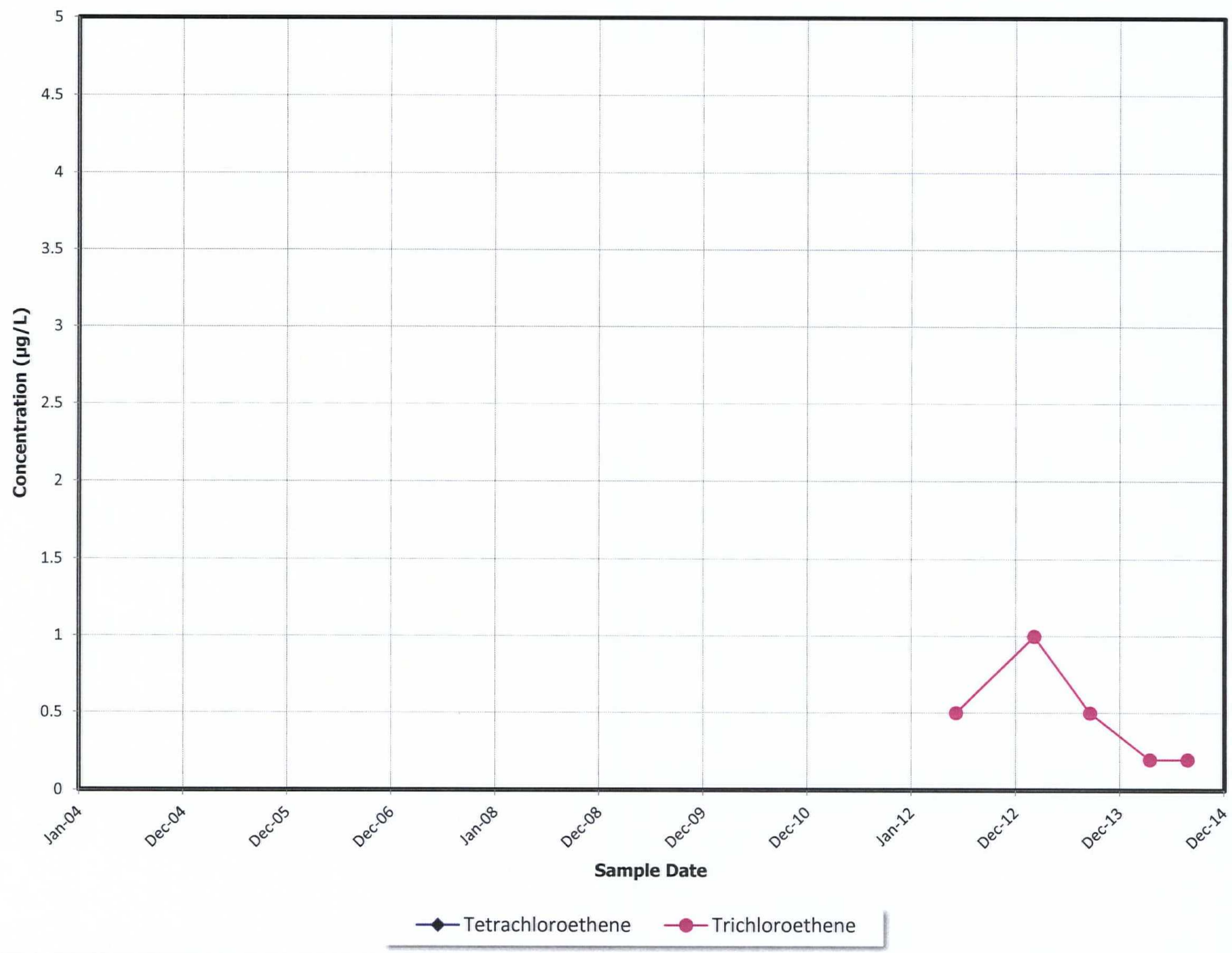

MW-4B
Concentration (µg/L)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Jan-04
Dec-04
Dec-05
Dec-06
Jan-08
Dec-08
Dec-09
Dec-10
Jan-12
Dec-12
Dec-13
Dec-14
Sample Date
Tetrachloroethene
Trichloroethene



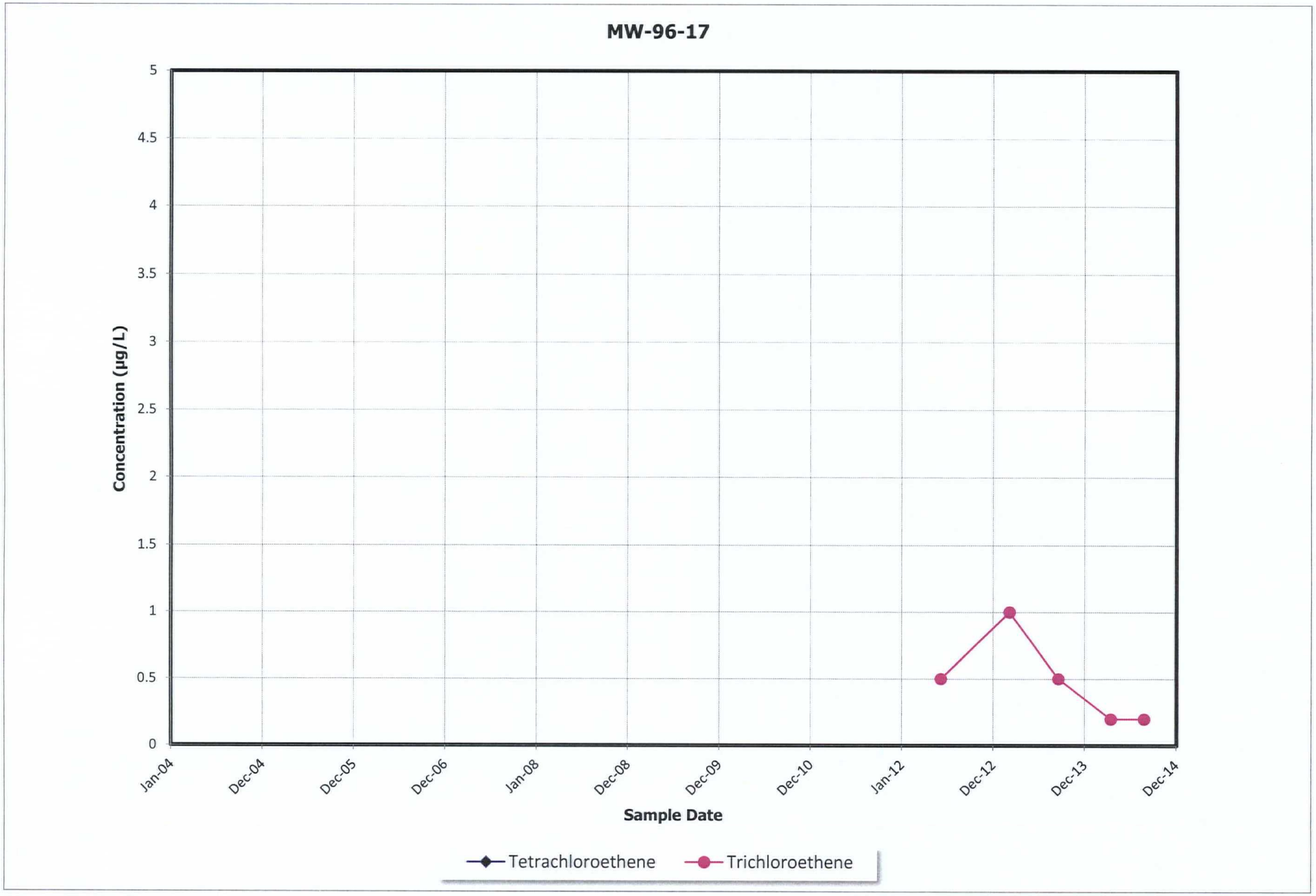
MW-93-02
Concentration (µg/L)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Jan-04
Dec-04
Dec-05
Dec-06
Jan-08
Dec-08
Dec-09
Dec-10
Jan-12
Dec-12
Dec-13
Dec-14
Sample Date
Tetrachloroethene
Trichloroethene


MW-96-15
Concentration (µg/L)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Jan-04
Dec-04
Dec-05
Dec-06
Jan-08
Dec-08
Dec-09
Dec-10
Jan-12
Dec-12
Dec-13
Dec-14
Sample Date
Tetrachloroethene
Trichloroethene

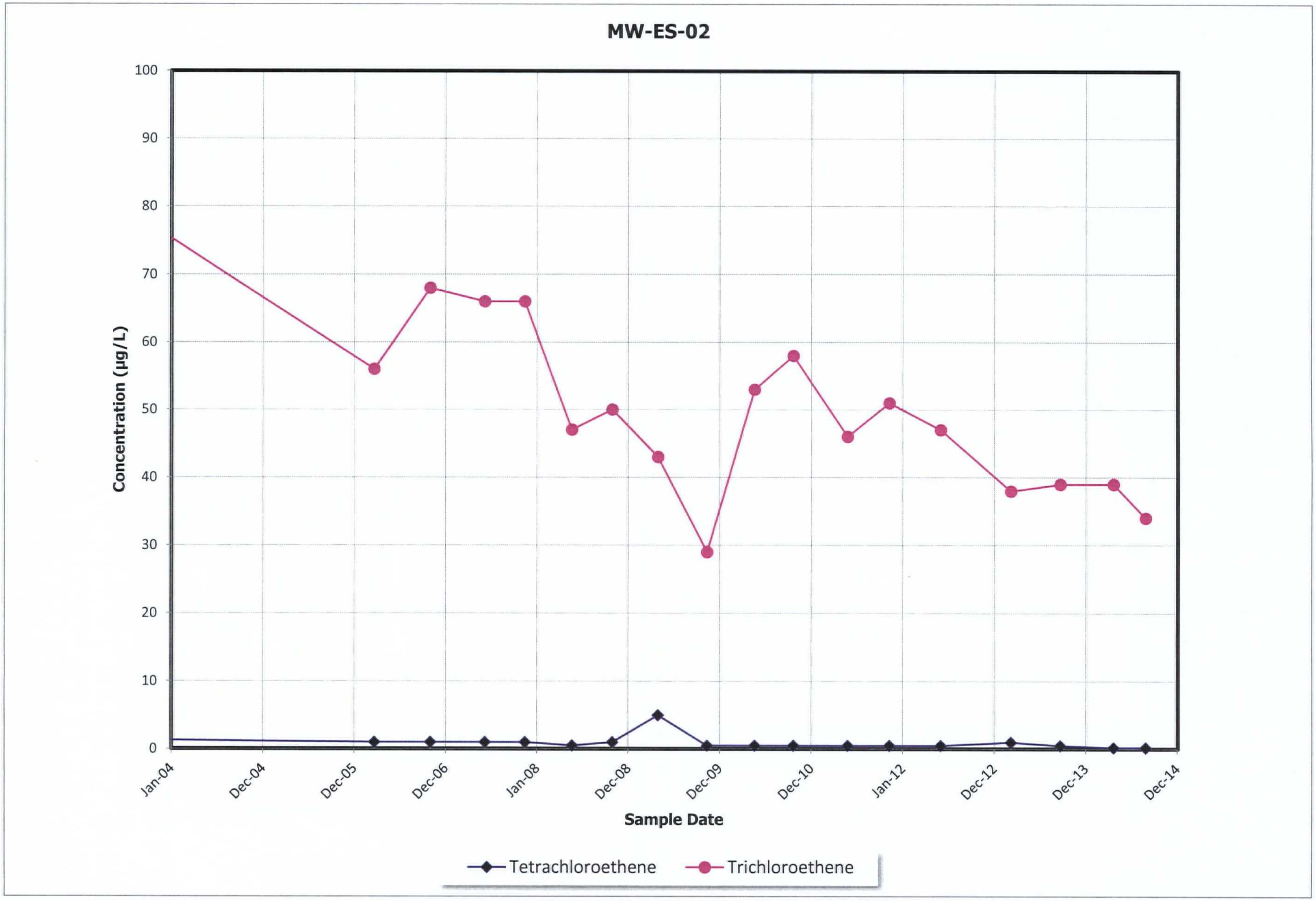
MW-96-16

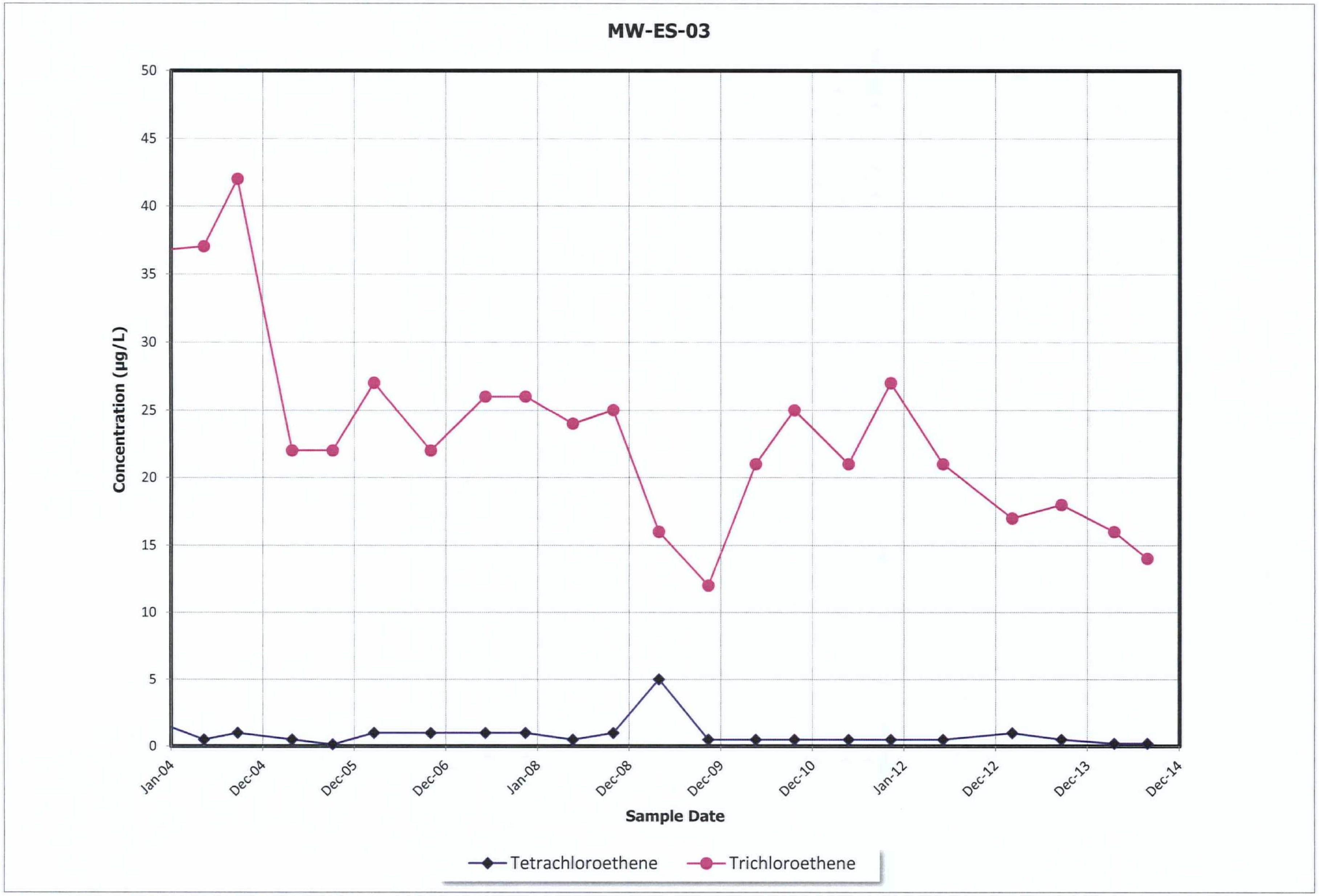


Concentration (µg/L)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Jan-04
Dec-04
Dec-05
Dec-06
Jan-08
Dec-08
Dec-09
Dec-10
Jan-12
Dec-12
Dec-13
Dec-14
Sample Date
Tetrachloroethene
Trichloroethene

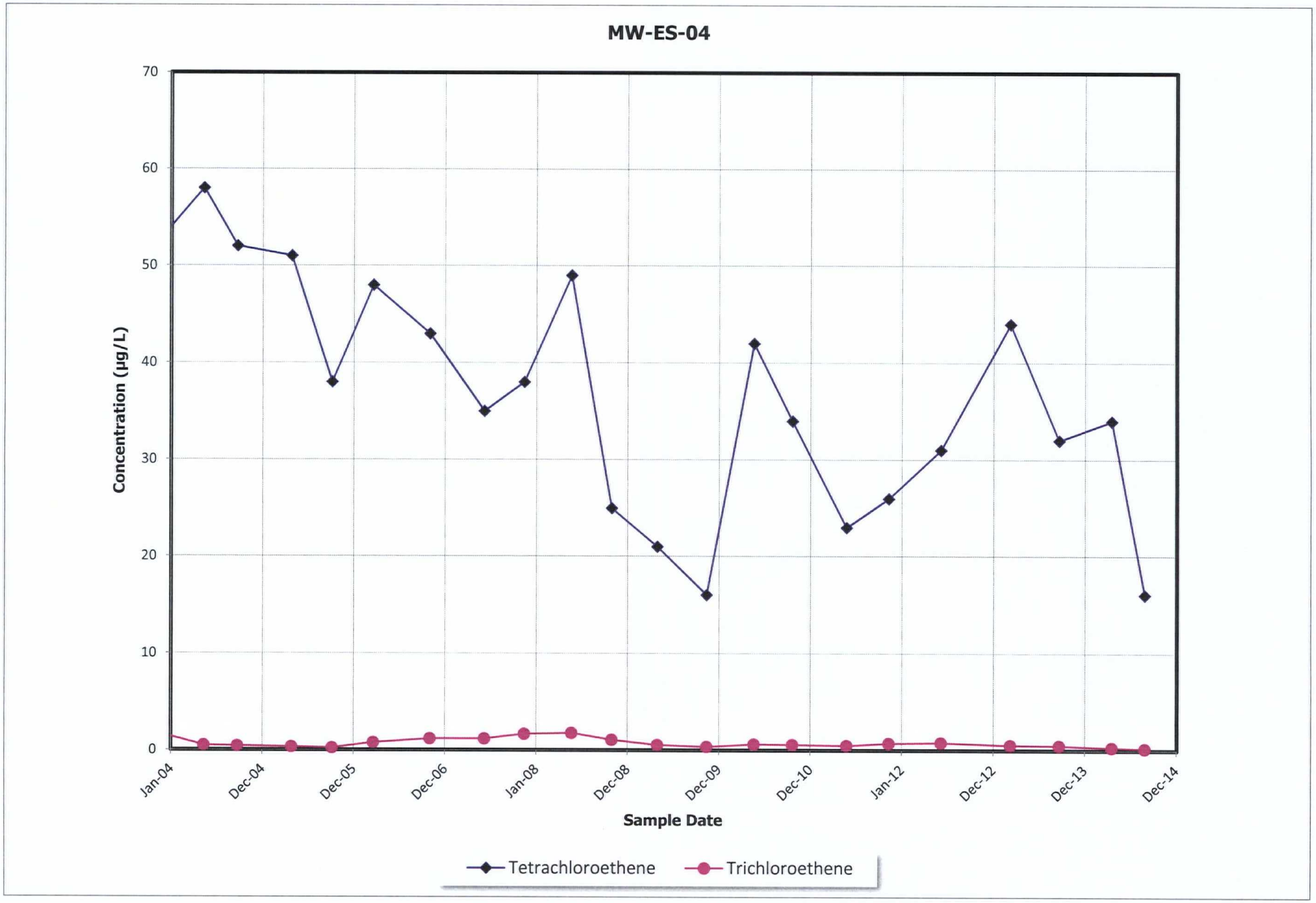


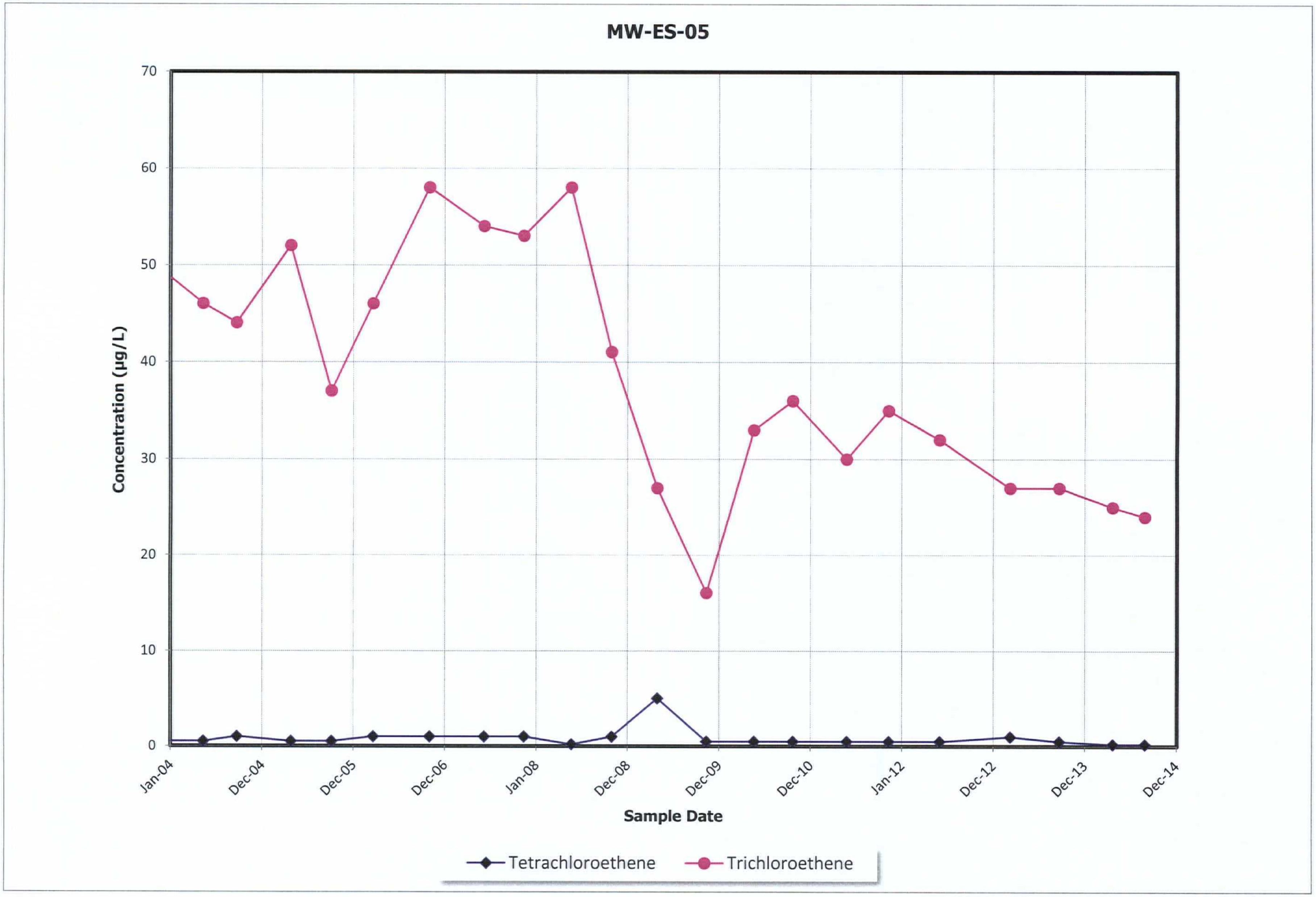
MW-96-17
Concentration (µg/L)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Jan-04
Dec-04
Dec-05
Dec-06
Jan-08
Dec-08
Dec-09
Dec-10
Jan-12
Dec-12
Dec-13
Dec-14
Sample Date
Tetrachloroethene
Trichloroethene


MW-ES-02
Concentration (µg/L)
0
10
20
30
40
50
60
70
80
90
100
Jan-04
Dec-04
Dec-05
Dec-06
Jan-08
Dec-08
Dec-09
Dec-10
Jan-12
Dec-12
Dec-13
Dec-14
Sample Date
Tetrachloroethene
Trichloroethene

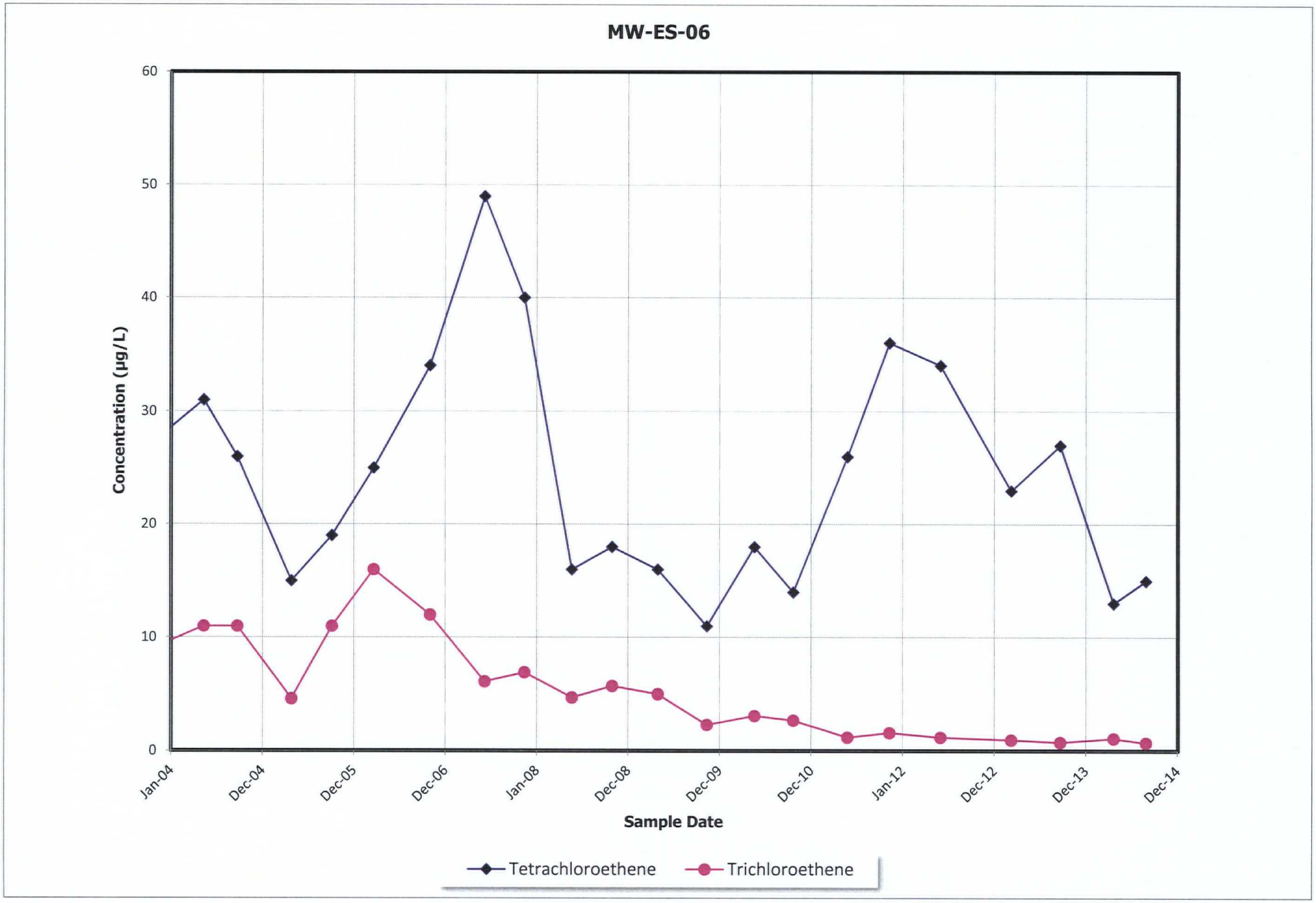


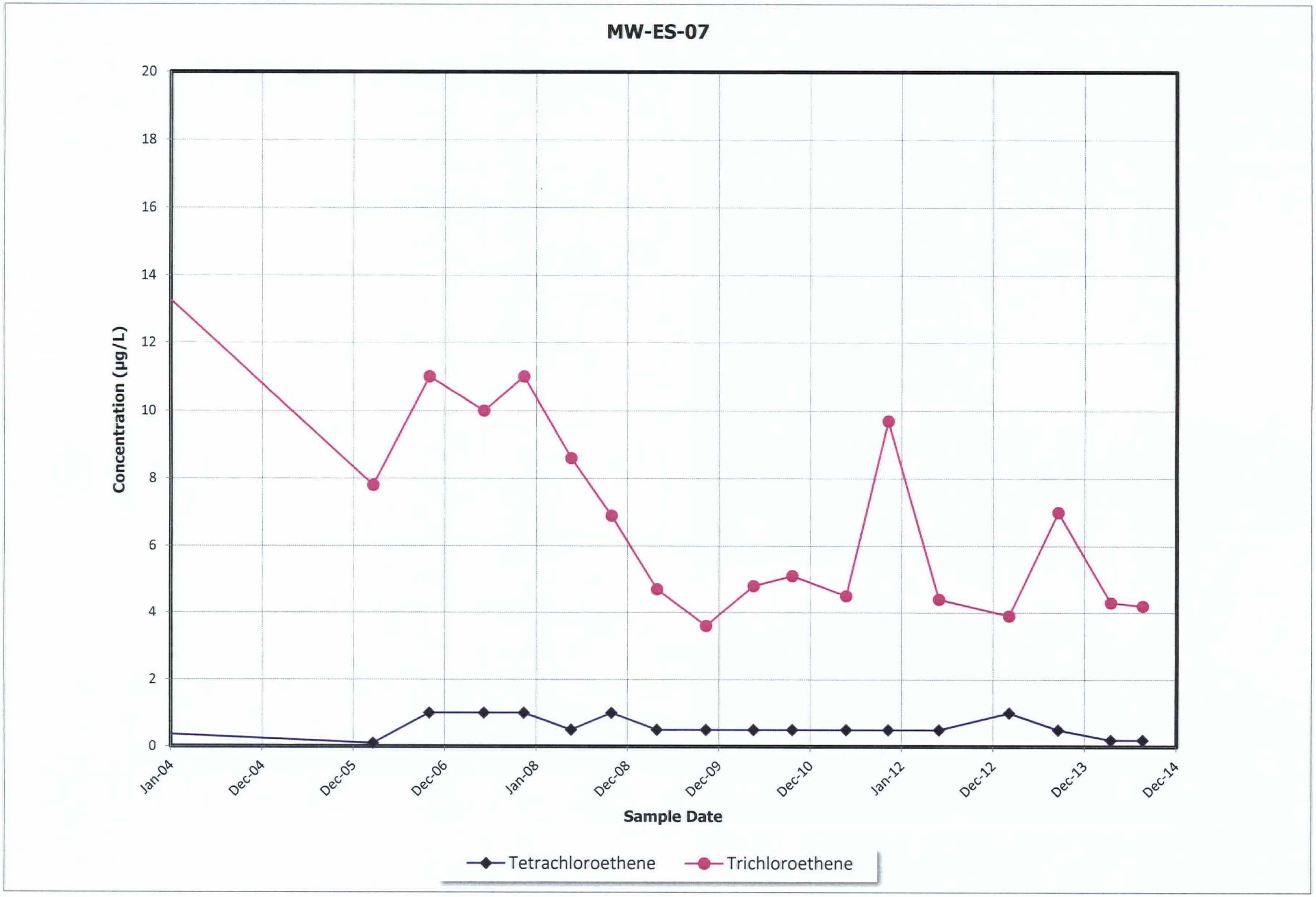
MW-ES-03
Concentration (µg/L)
50
45
40
35
30
25
20
15
10
5
0
Jan-04
Dec-04
Dec-05
Dec-06
Jan-08
Dec-08
Dec-09
Dec-10
Jan-12
Dec-12
Dec-13
Dec-14
Sample Date
Tetrachloroethene
Trichloroethene

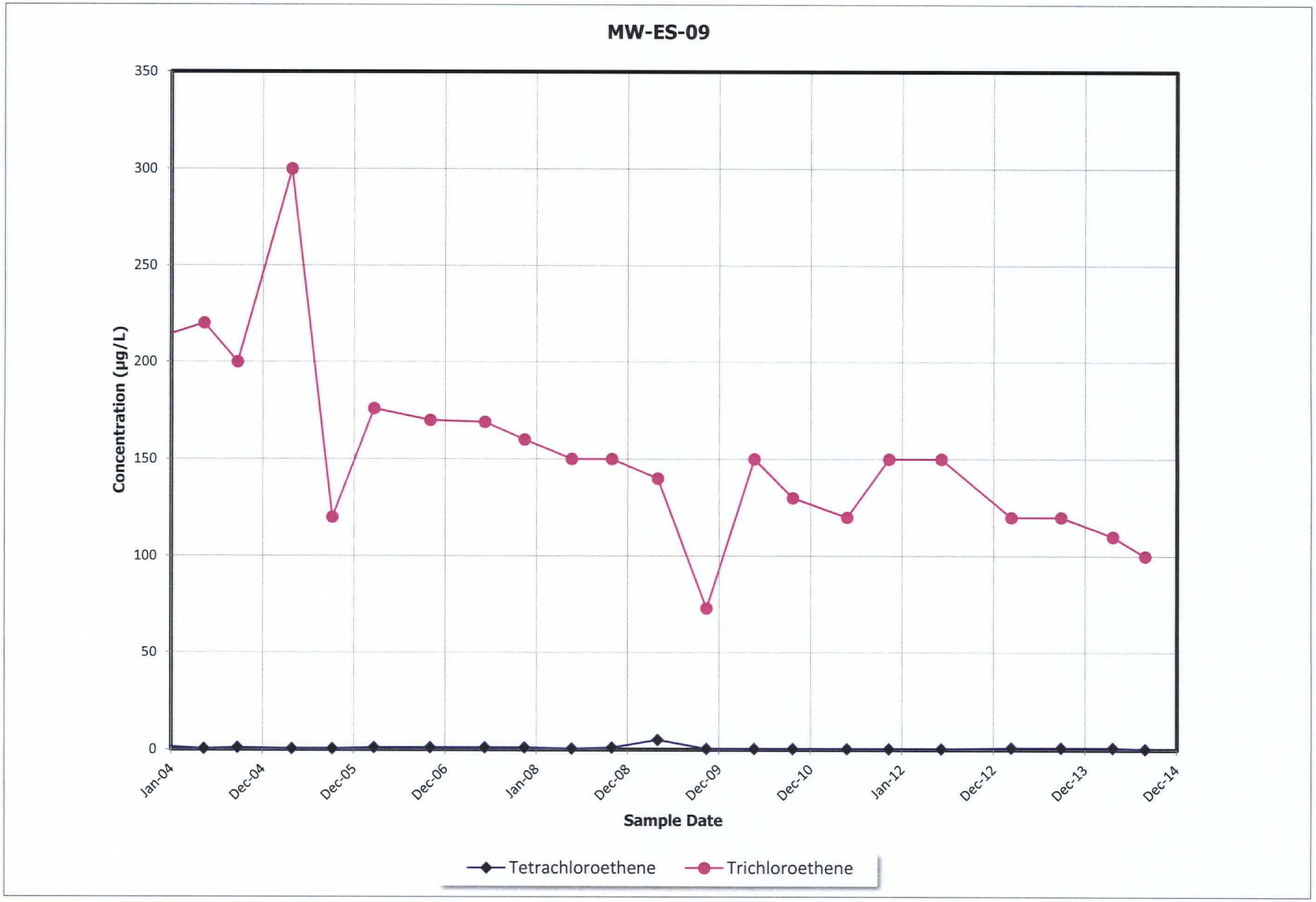

MW-ES-04
Concentration (µg/L)
70
60
50
40
30
20
10
0
Jan-04
Dec-04
Dec-05
Dec-06
Jan-08
Dec-08
Dec-09
Dec-10
Jan-12
Dec-12
Dec-13
Dec-14
Sample Date
Tetrachloroethene
Trichloroethene

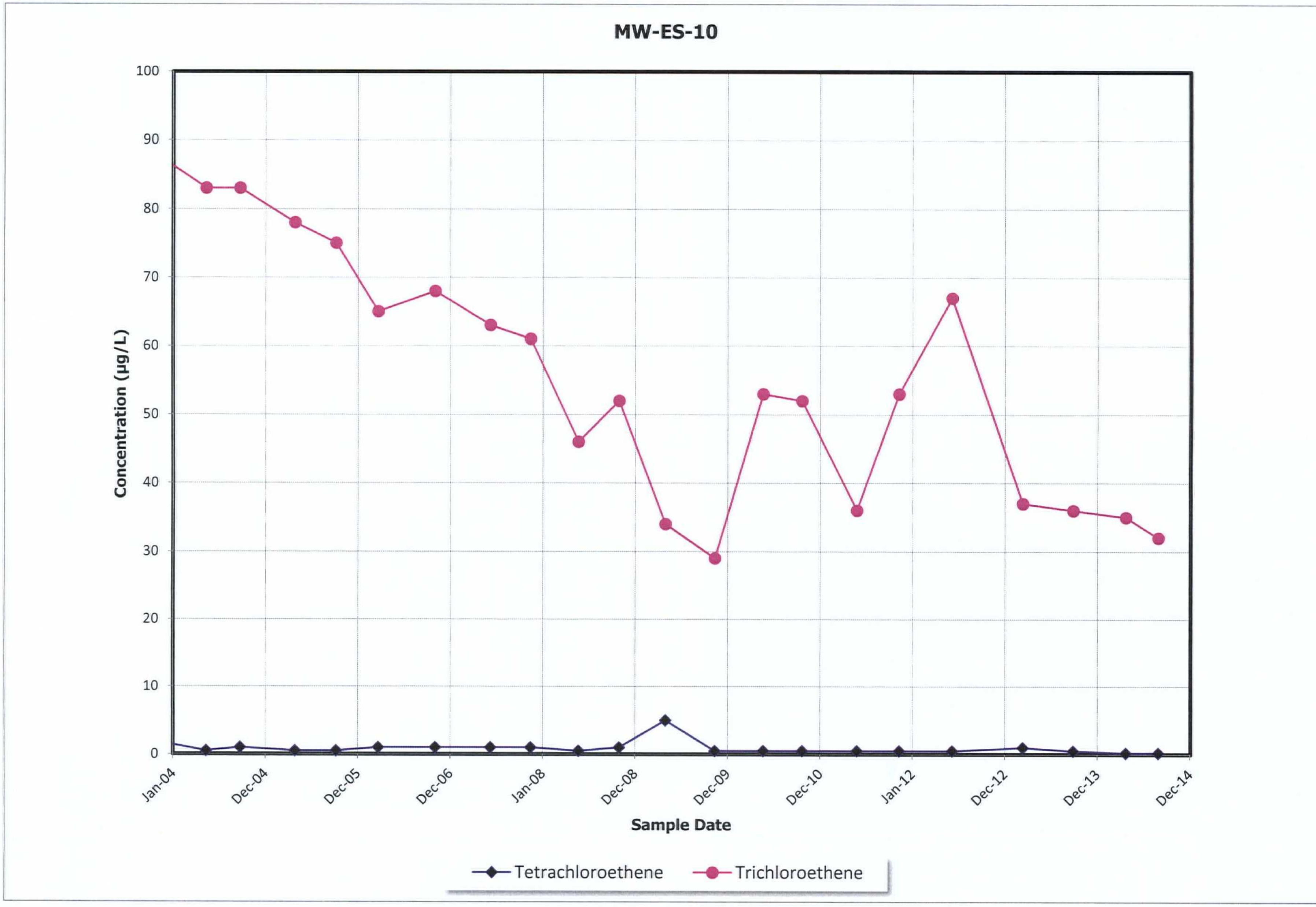


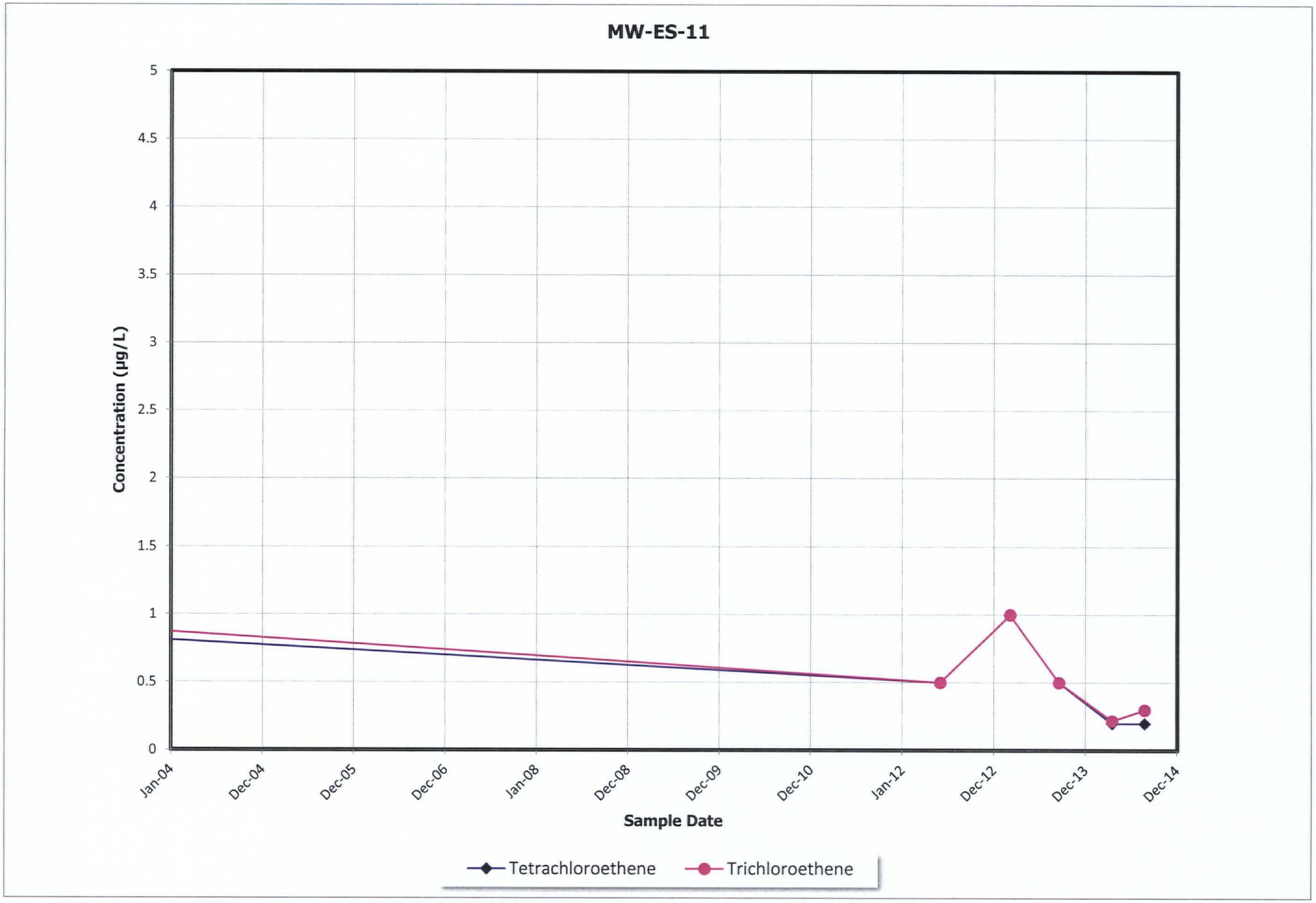
MW-ES-05
Concentration (µg/L)
70
60
50
40
30
20
10
0
Jan-04
Dec-04
Dec-05
Dec-06
Jan-08
Dec-08
Dec-09
Dec-10
Jan-12
Dec-12
Dec-13
Dec-14
Sample Date
Tetrachloroethene
Trichloroethene

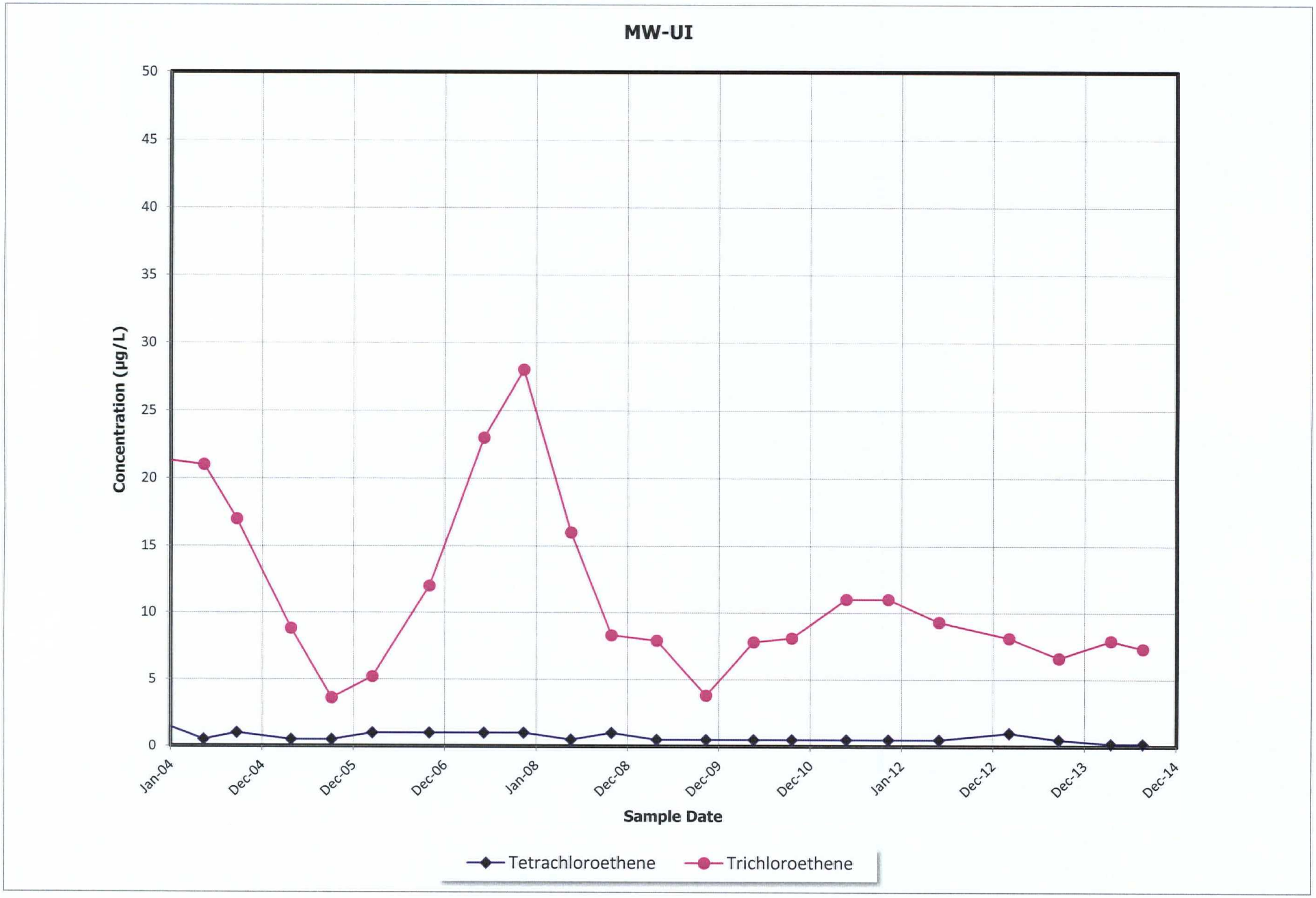

MW-ES-06
Concentration (µg/L)
0
10
20
30
40
50
60
Jan-04
Dec-04
Dec-05
Dec-06
Jan-08
Dec-08
Dec-09
Dec-10
Jan-12
Dec-12
Dec-13
Dec-14
Sample Date
Tetrachloroethene
Trichloroethene


MW-ES-07
Concentration (µg/L)
0
2
4
6
8
10
12
14
16
18
20
Jan-04
Dec-04
Dec-05
Dec-06
Jan-08
Dec-08
Dec-09
Dec-10
Jan-12
Dec-12
Dec-13
Dec-14
Sample Date
Tetrachloroethene
Trichloroethene

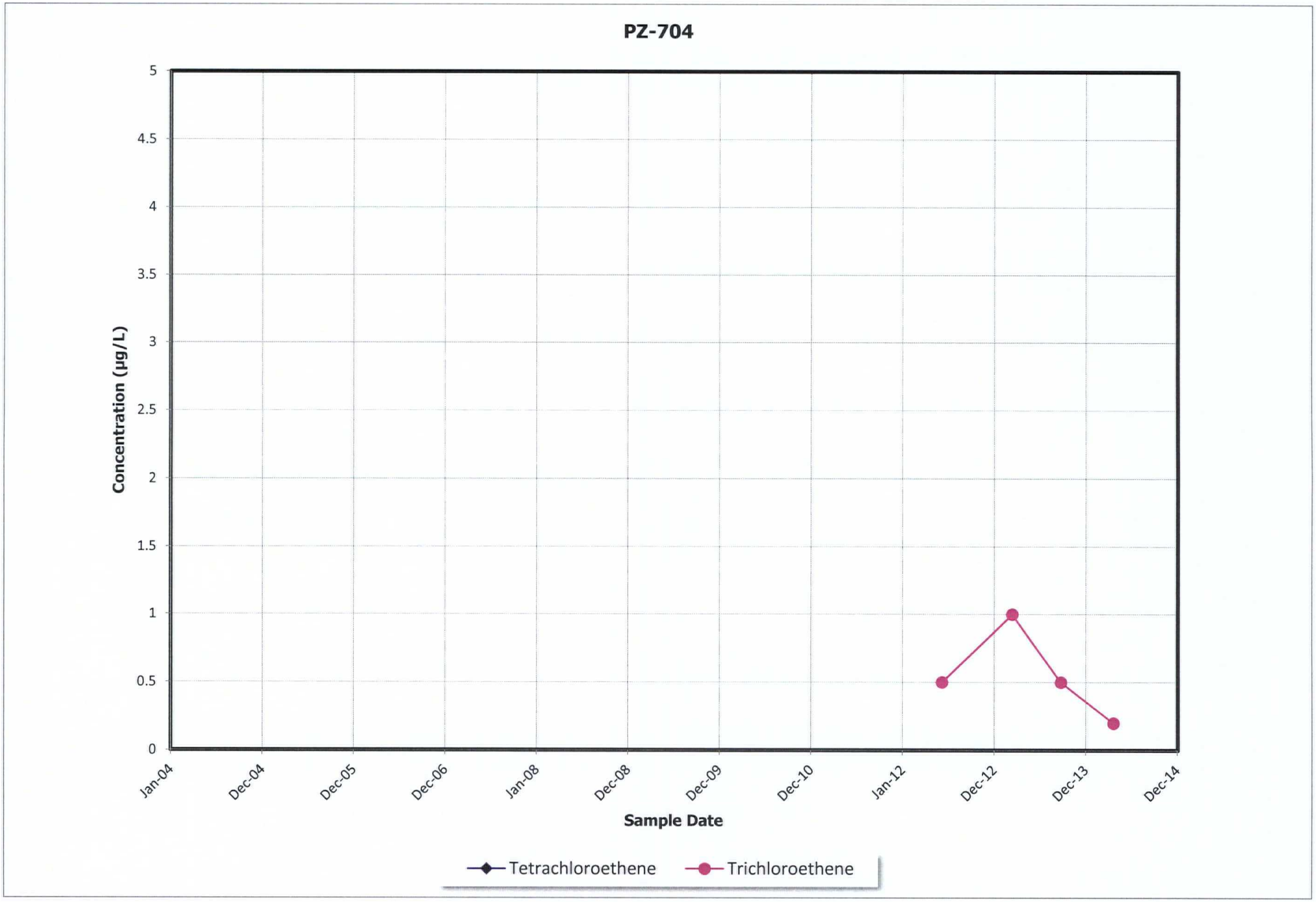

MW-ES-09
Concentration (µg/L)
350
300
250
200
150
100
50
0
Jan-04
Dec-04
Dec-05
Dec-06
Jan-08
Dec-08
Dec-09
Dec-10
Jan-12
Dec-12
Dec-13
Dec-14
Sample Date
Tetrachloroethene
Trichloroethene

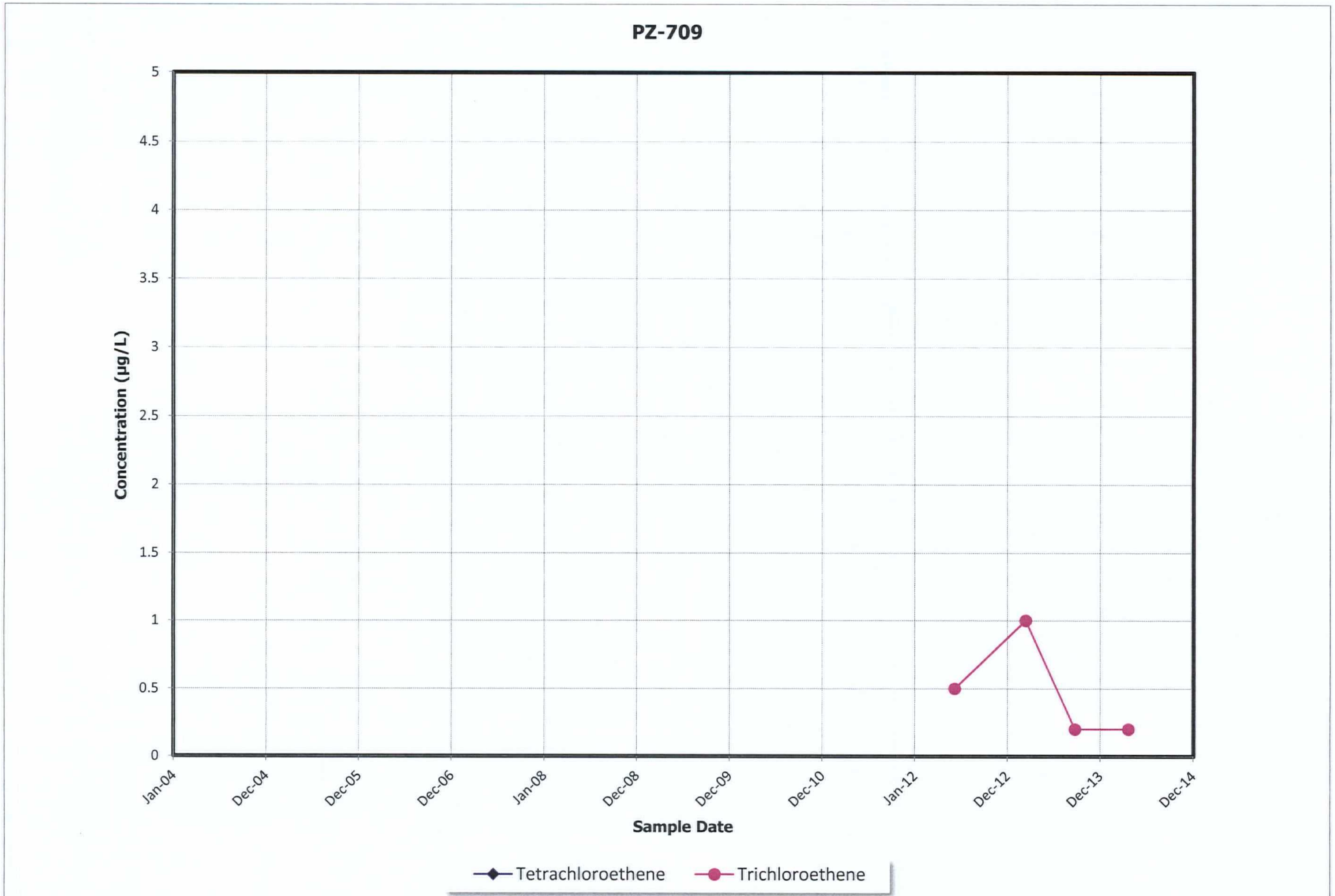

MW-ES-10
Concentration (µg/L)
0
10
20
30
40
50
60
70
80
90
100
Jan-04
Dec-04
Dec-05
Dec-06
Jan-08
Dec-08
Dec-09
Dec-10
Jan-12
Dec-12
Dec-13
Dec-14
Sample Date
Tetrachloroethene
Trichloroethene

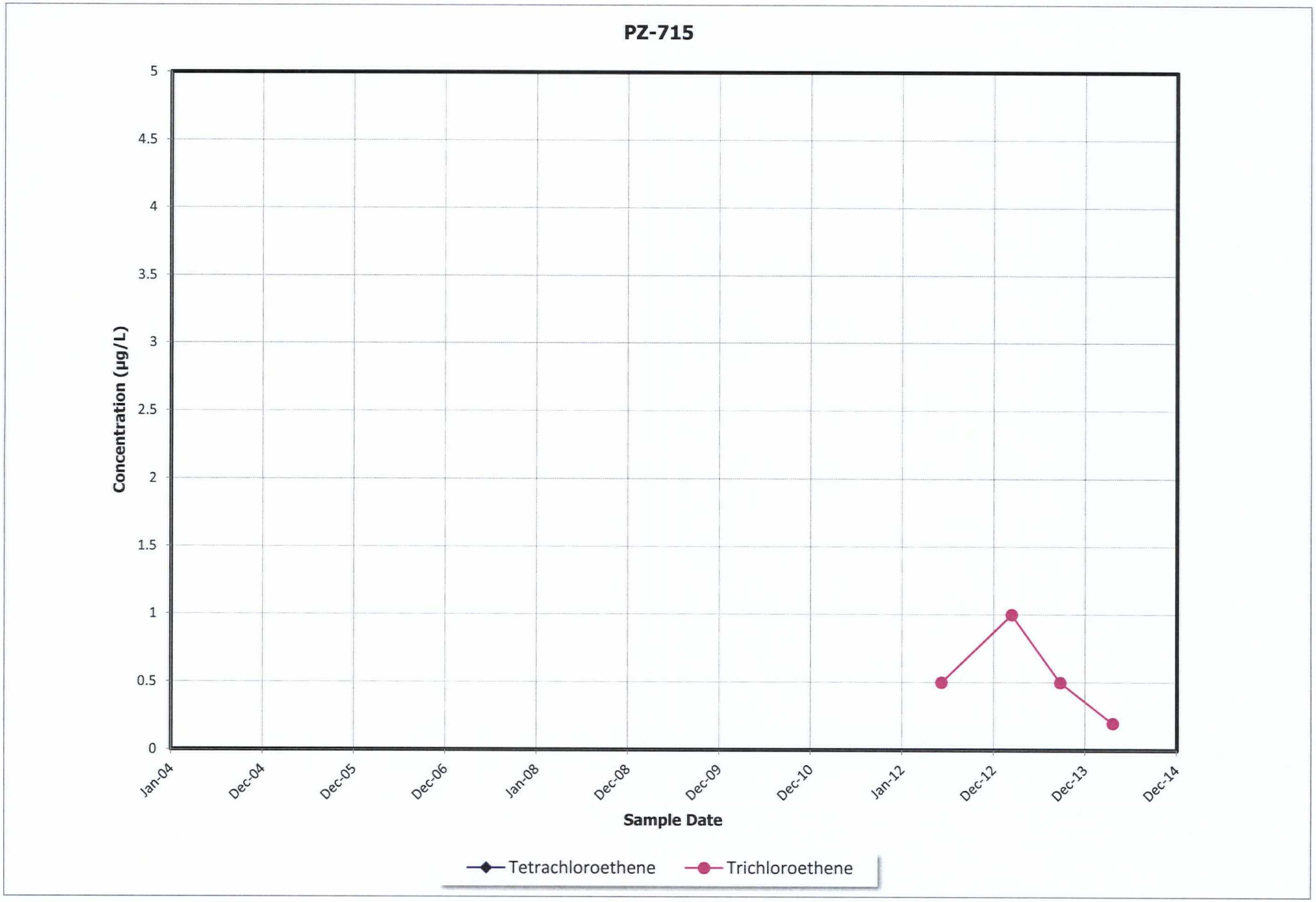

MW-ES-11
Concentration (µg/L)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Jan-04
Dec-04
Dec-05
Dec-06
Jan-08
Dec-08
Dec-09
Dec-10
Jan-12
Dec-12
Dec-13
Dec-14
Sample Date
Tetrachloroethene
Trichloroethene

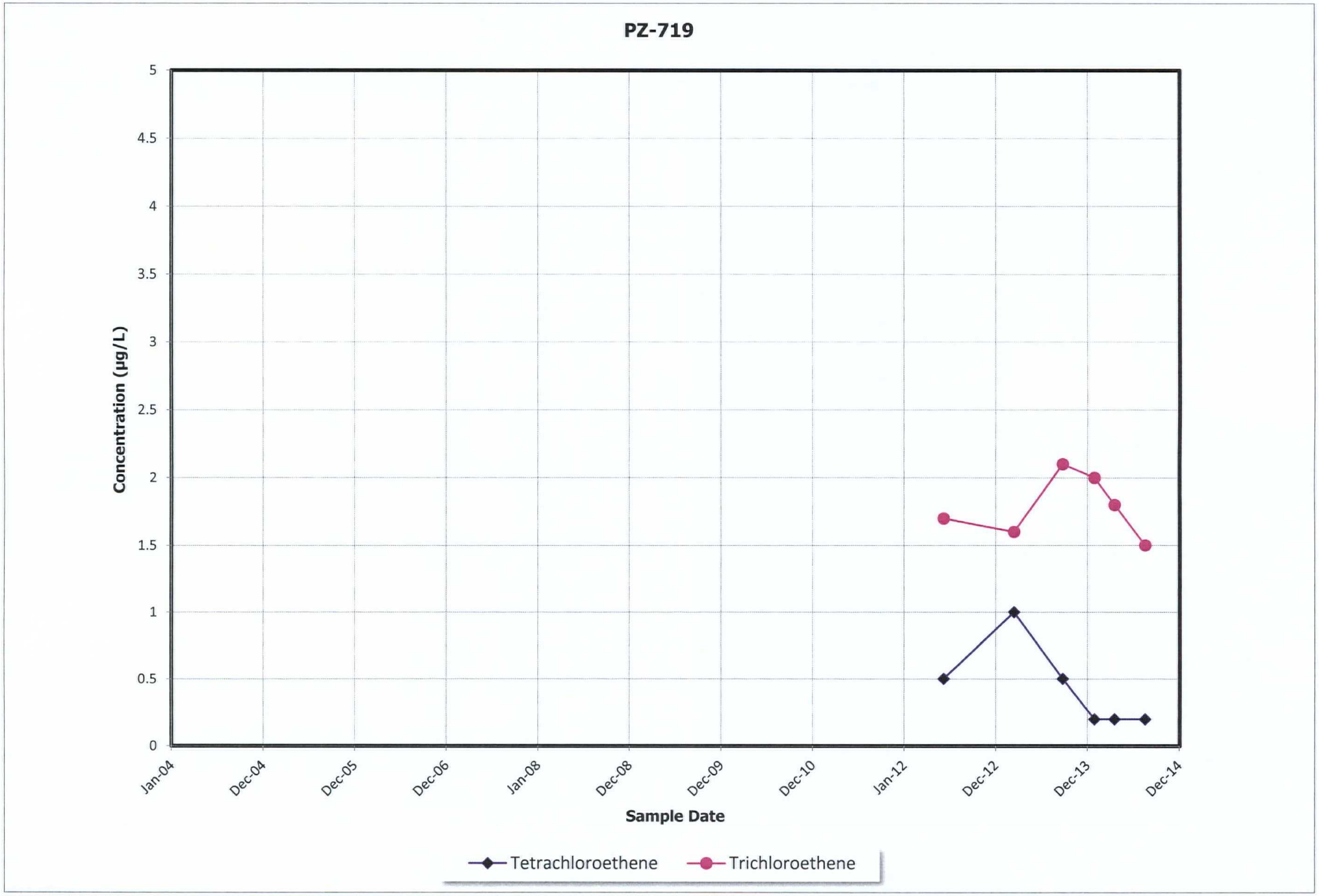


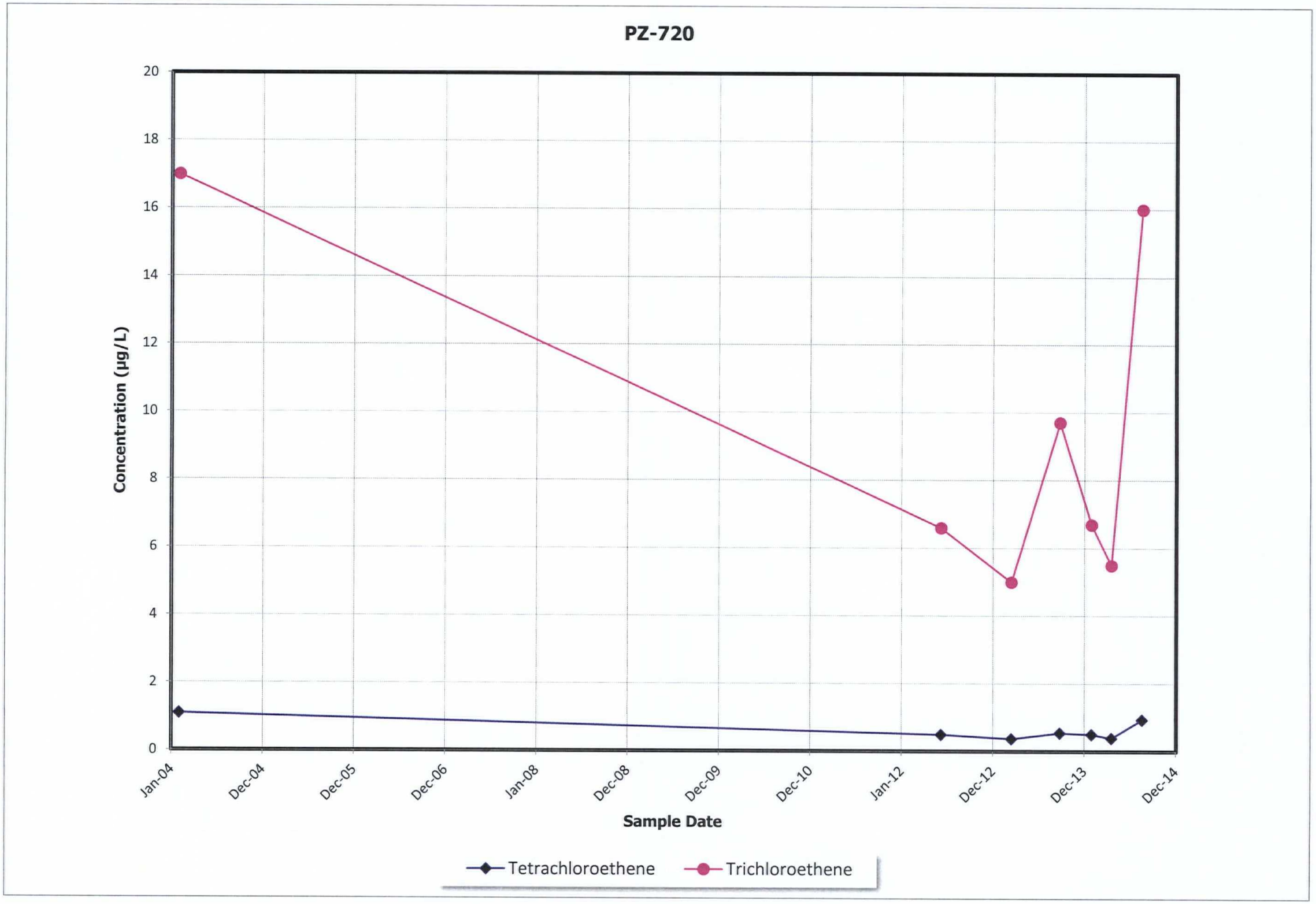
MW-UI
50
45
40
35
30
25
20
15
10
5
0
Concentration (µg/L)
Jan-04
Dec-04
Dec-05
Dec-06
Jan-08
Dec-08
Dec-09
Dec-10
Jan-12
Dec-12
Dec-13
Dec-14
Sample Date
Tetrachloroethene
Trichloroethene

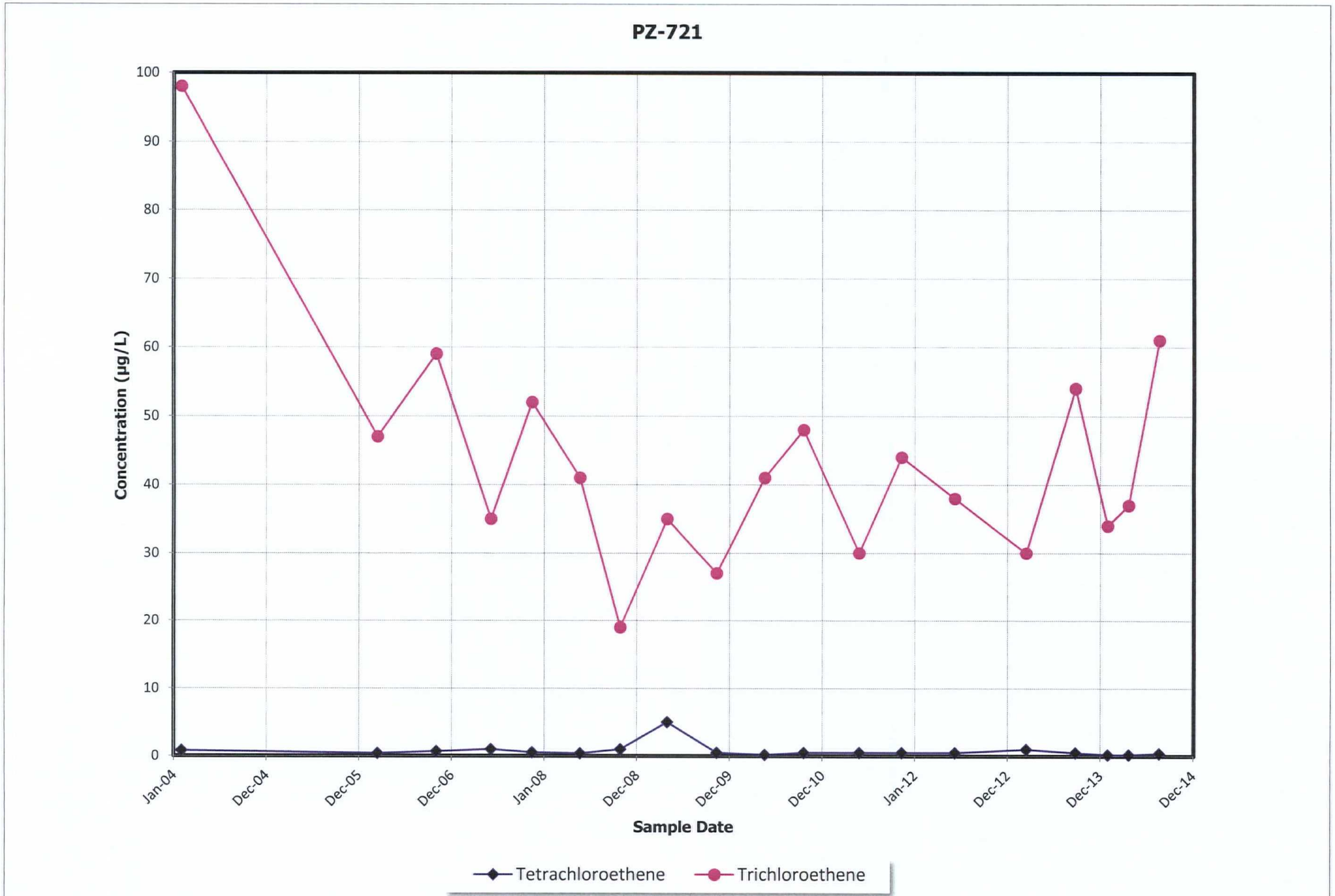

PZ-704
Concentration (µg/L)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
Jan-04
Dec-04
Dec-05
Dec-06
Jan-08
Dec-08
Dec-09
Dec-10
Jan-12
Dec-12
Dec-13
Dec-14
Sample Date
Tetrachloroethene
Trichloroethene

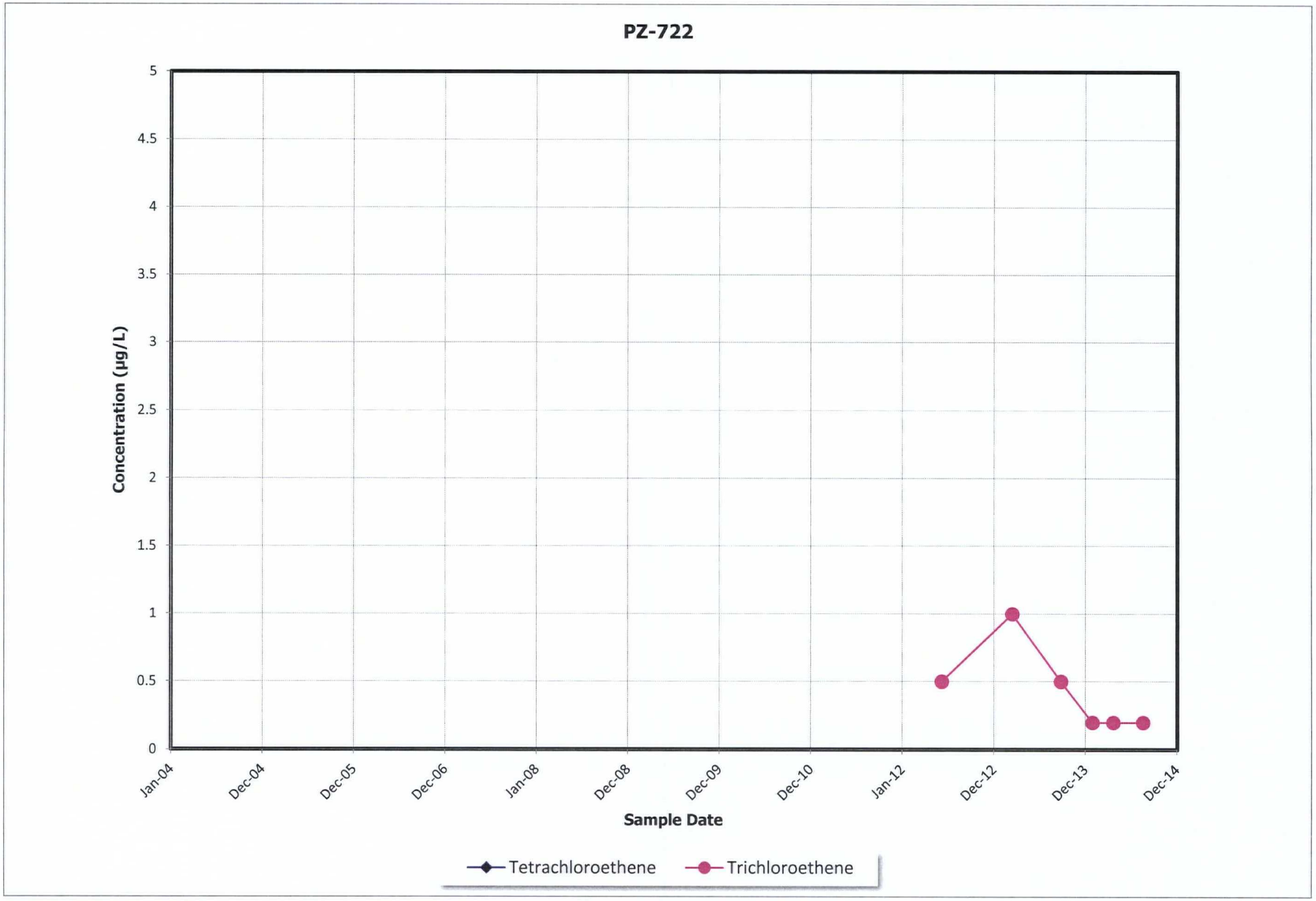

PZ-709
Concentration (µg/L)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Jan-04
Dec-04
Dec-05
Dec-06
Jan-08
Dec-08
Dec-09
Dec-10
Jan-12
Dec-12
Dec-13
Dec-14
Sample Date
Tetrachloroethene
Trichloroethene


PZ-715
Concentration (µg/L)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Jan-04
Dec-04
Dec-05
Dec-06
Jan-08
Dec-08
Dec-09
Dec-10
Jan-12
Dec-12
Dec-13
Dec-14
Sample Date
Tetrachloroethene
Trichloroethene

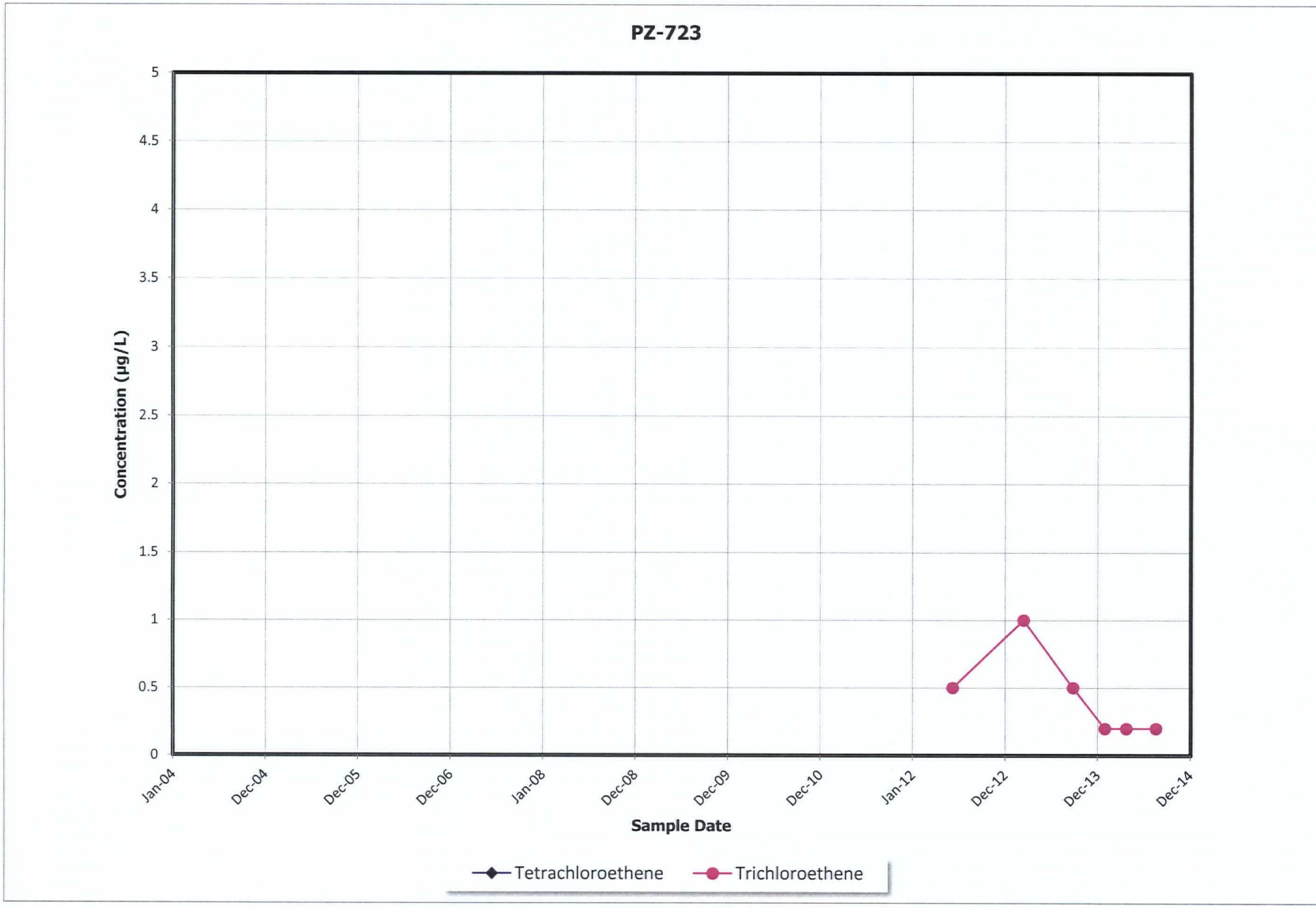

PZ-719
Concentration (µg/L)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Jan-04
Dec-04
Dec-05
Dec-06
Jan-08
Dec-08
Dec-09
Dec-10
Jan-12
Dec-12
Dec-13
Dec-14
Sample Date
Tetrachloroethene
Trichloroethene

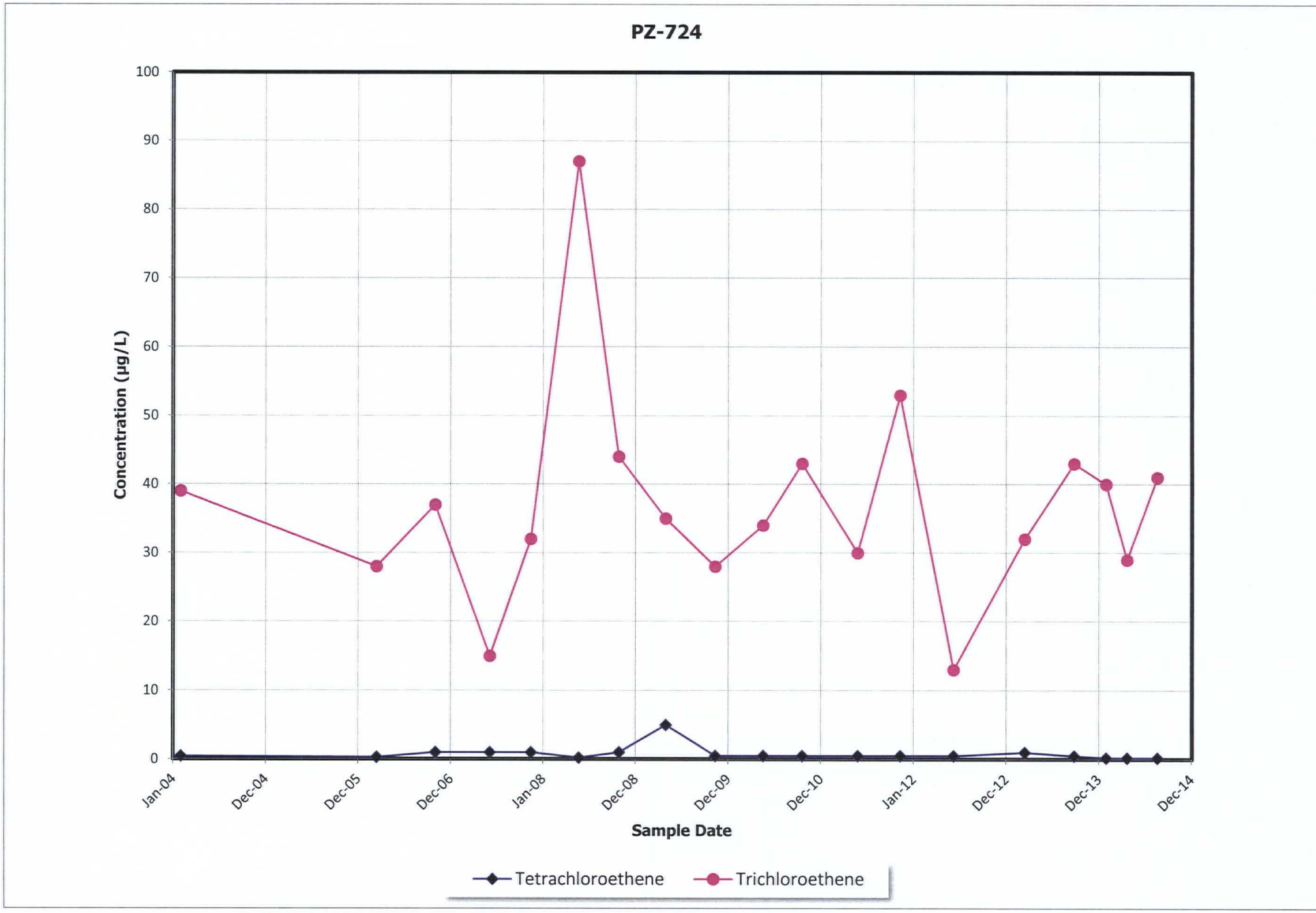

PZ-720
Concentration (µg/L)
20
18
16
14
12
10
8
6
4
2
0
Jan-04
Dec-04
Dec-05
Dec-06
Jan-08
Dec-08
Dec-09
Dec-10
Jan-12
Dec-12
Dec-13
Dec-14
Sample Date
Tetrachloroethene
Trichloroethene

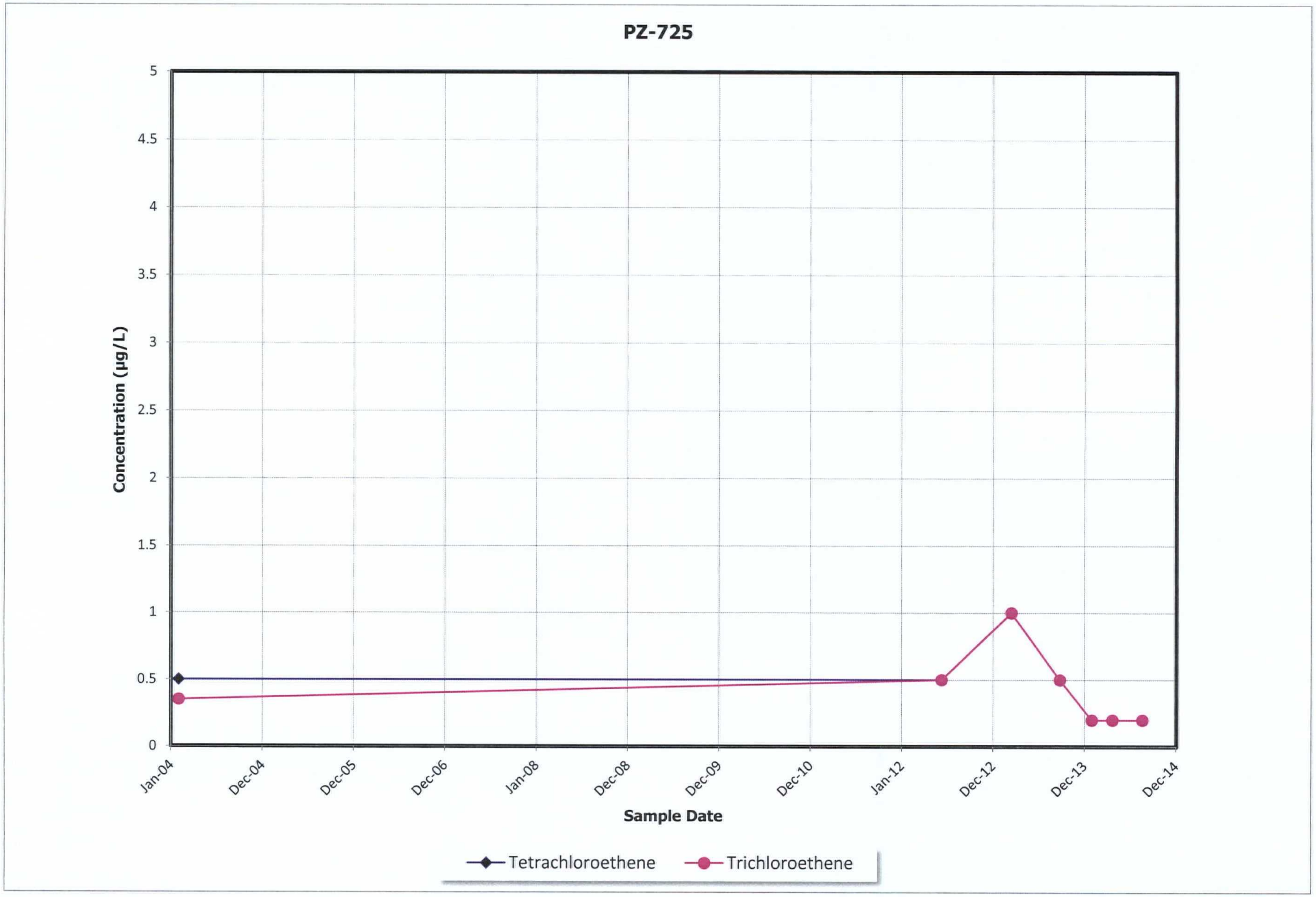

PZ-721
Concentration (µg/L)
100
90
80
70
60
50
40
30
20
10
0
Jan-04
Dec-04
Dec-05
Dec-06
Jan-08
Dec-08
Dec-09
Dec-10
Jan-12
Dec-12
Dec-13
Dec-14
Sample Date
Tetrachloroethene
Trichloroethene

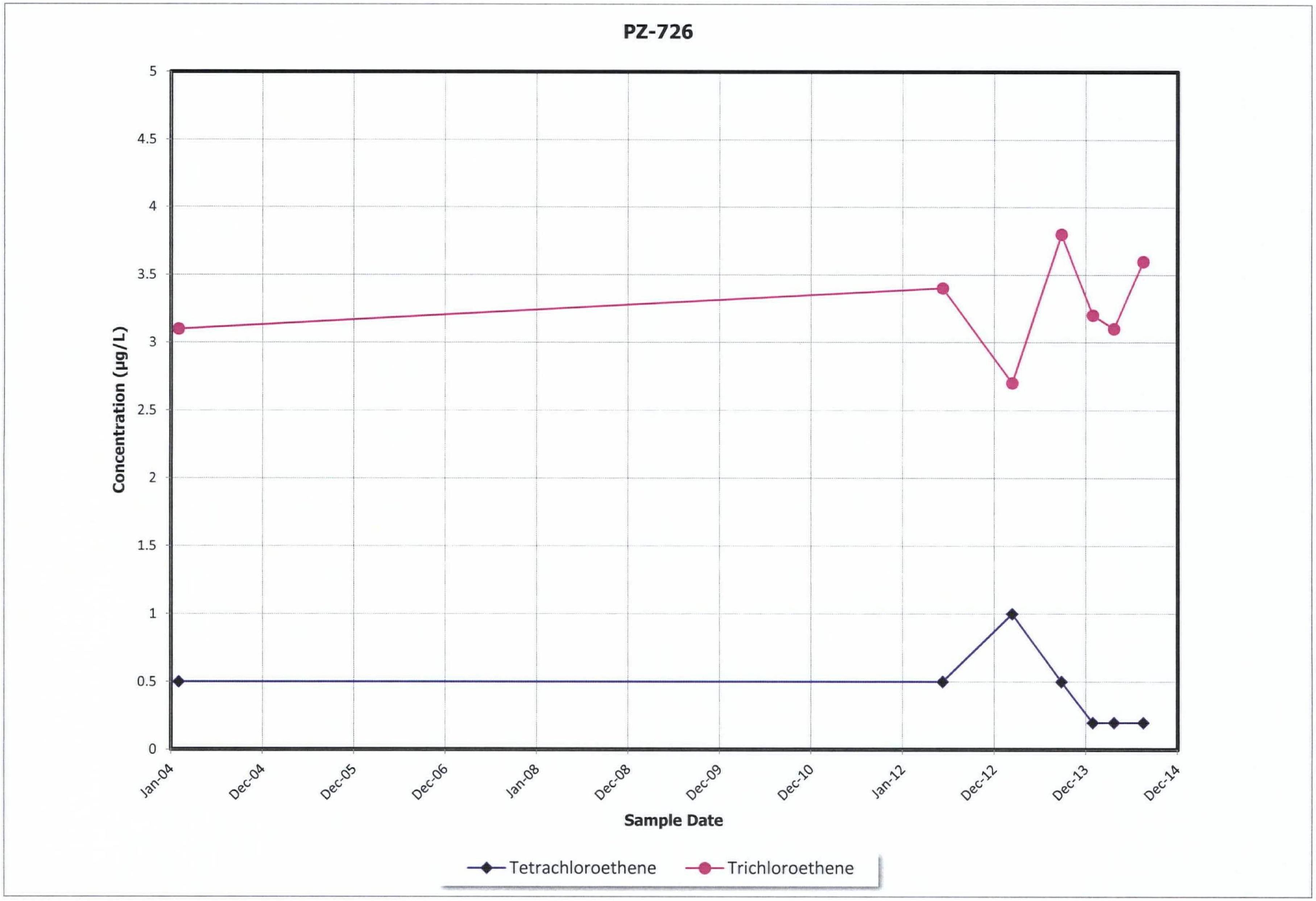


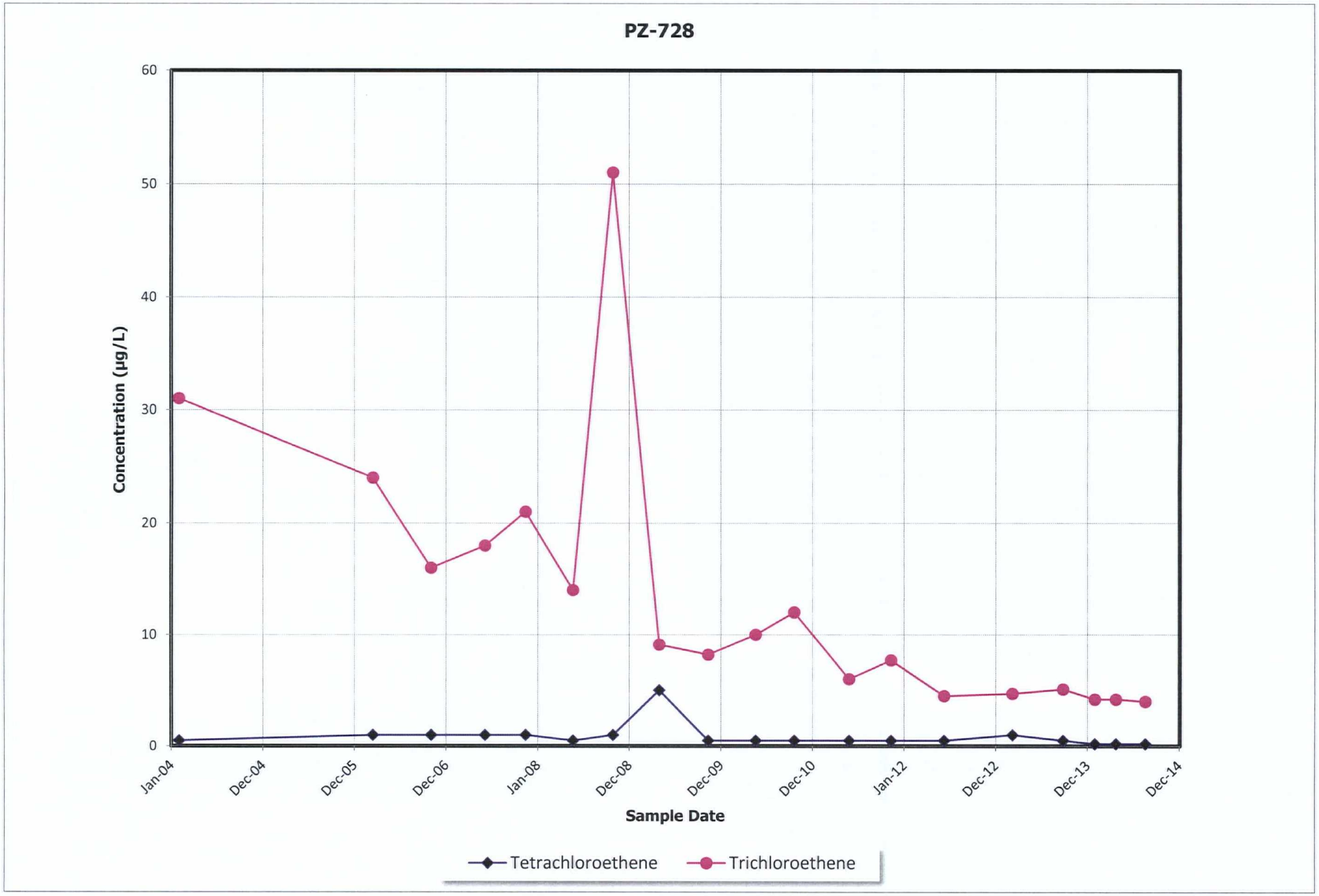
PZ-722
Concentration (µg/L)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Jan-04
Dec-04
Dec-05
Dec-06
Jan-08
Dec-08
Dec-09
Dec-10
Jan-12
Dec-12
Dec-13
Dec-14
Sample Date
Tetrachloroethene
Trichloroethene


PZ-723
Concentration (µg/L)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Jan-04
Dec-04
Dec-05
Dec-06
Jan-08
Dec-08
Dec-09
Dec-10
Jan-12
Dec-12
Dec-13
Dec-14
Sample Date
Tetrachloroethene
Trichloroethene

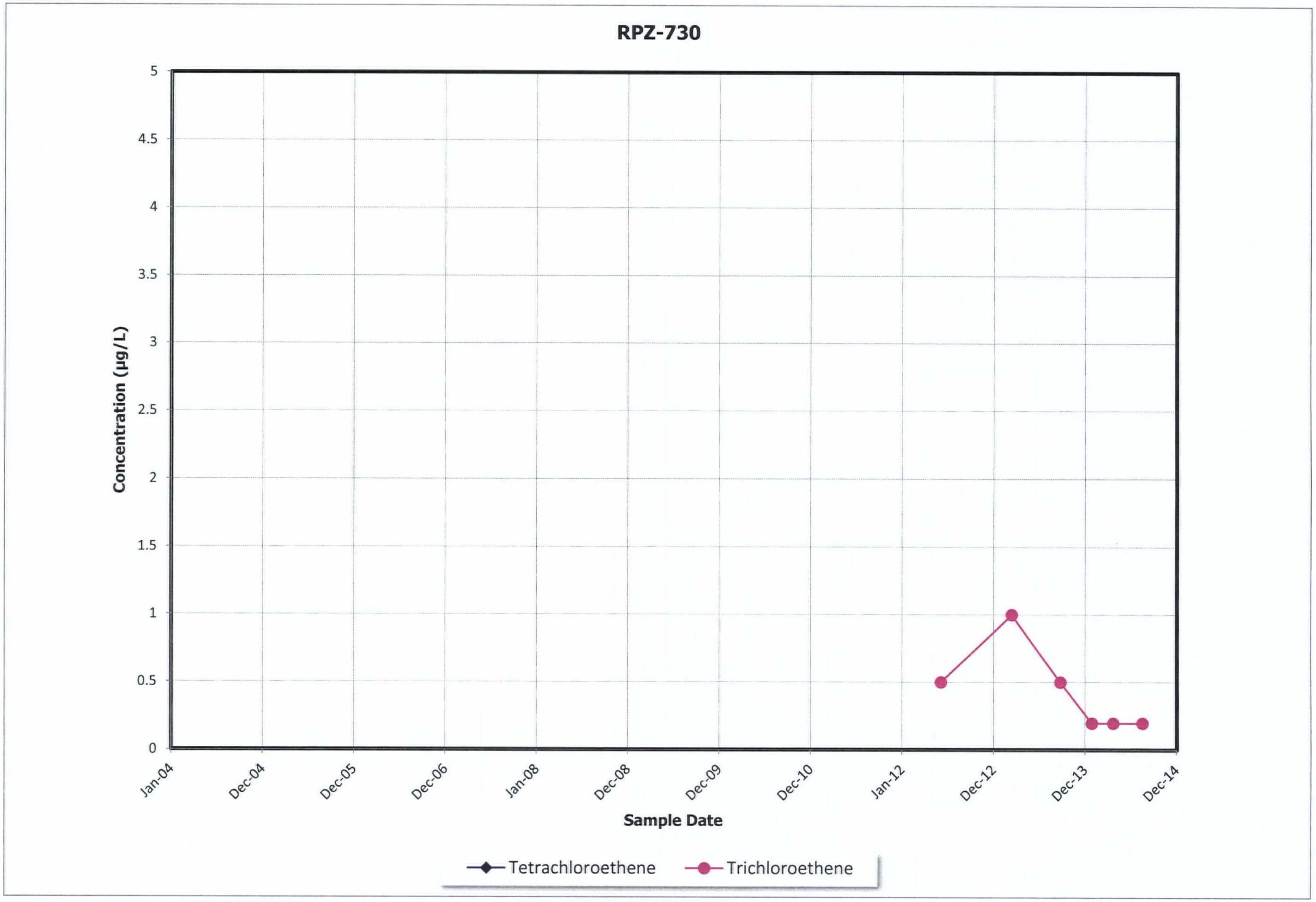

PZ-724
Concentration (µg/L)
100
90
80
70
60
50
40
30
20
10
0
Jan-04
Dec-04
Dec-05
Dec-06
Jan-08
Dec-08
Dec-09
Dec-10
Jan-12
Dec-12
Dec-13
Dec-14
Sample Date
Tetrachloroethene
Trichloroethene

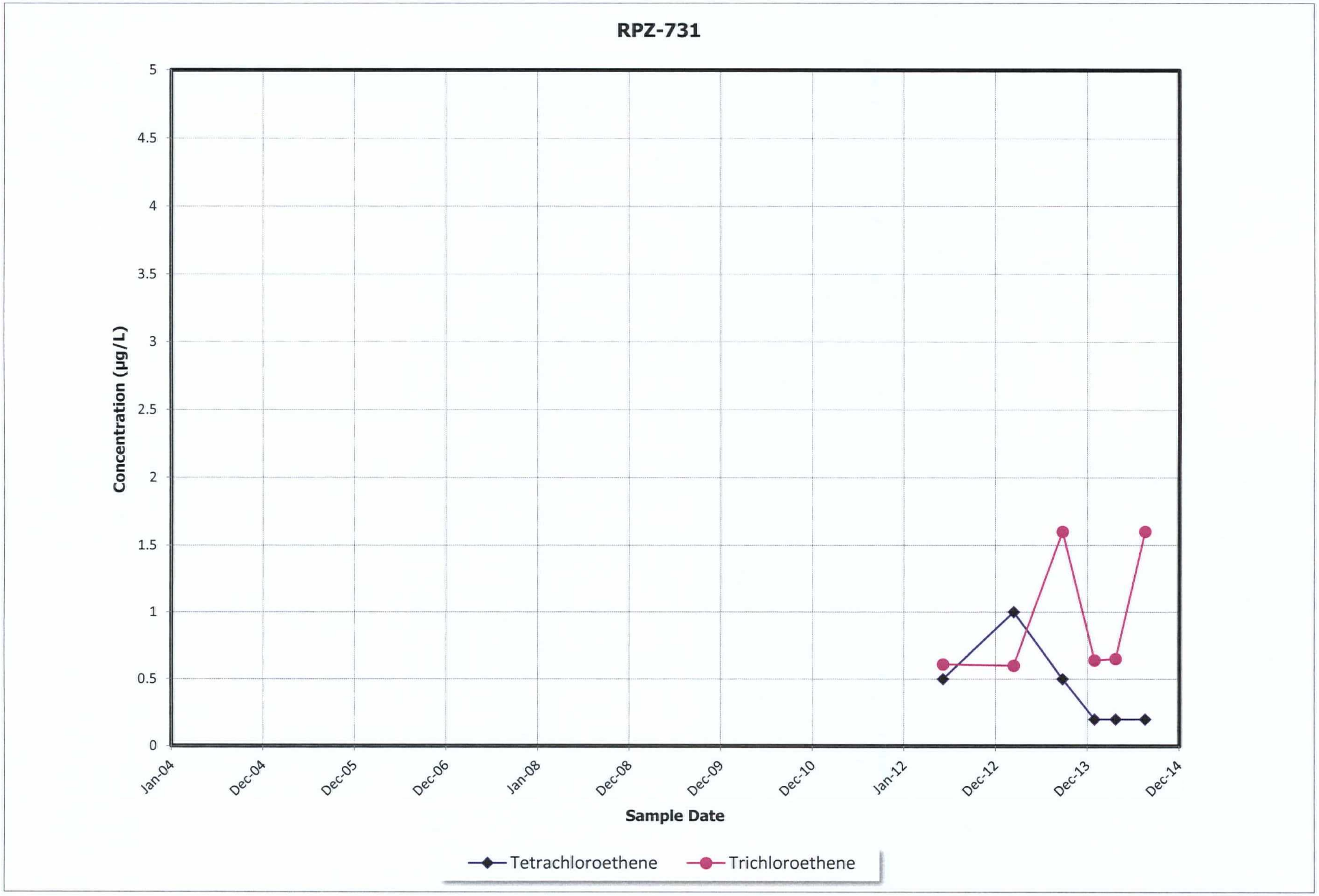

PZ-725
Concentration (µg/L)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
Jan-04
Dec-04
Dec-05
Dec-06
Jan-08
Dec-08
Dec-09
Dec-10
Jan-12
Dec-12
Dec-13
Dec-14
Sample Date
Tetrachloroethene
Trichloroethene


PZ-726
Concentration (µg/L)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Jan-04
Dec-04
Dec-05
Dec-06
Jan-08
Dec-08
Dec-09
Dec-10
Jan-12
Dec-12
Dec-13
Dec-14
Sample Date
Tetrachloroethene
Trichloroethene

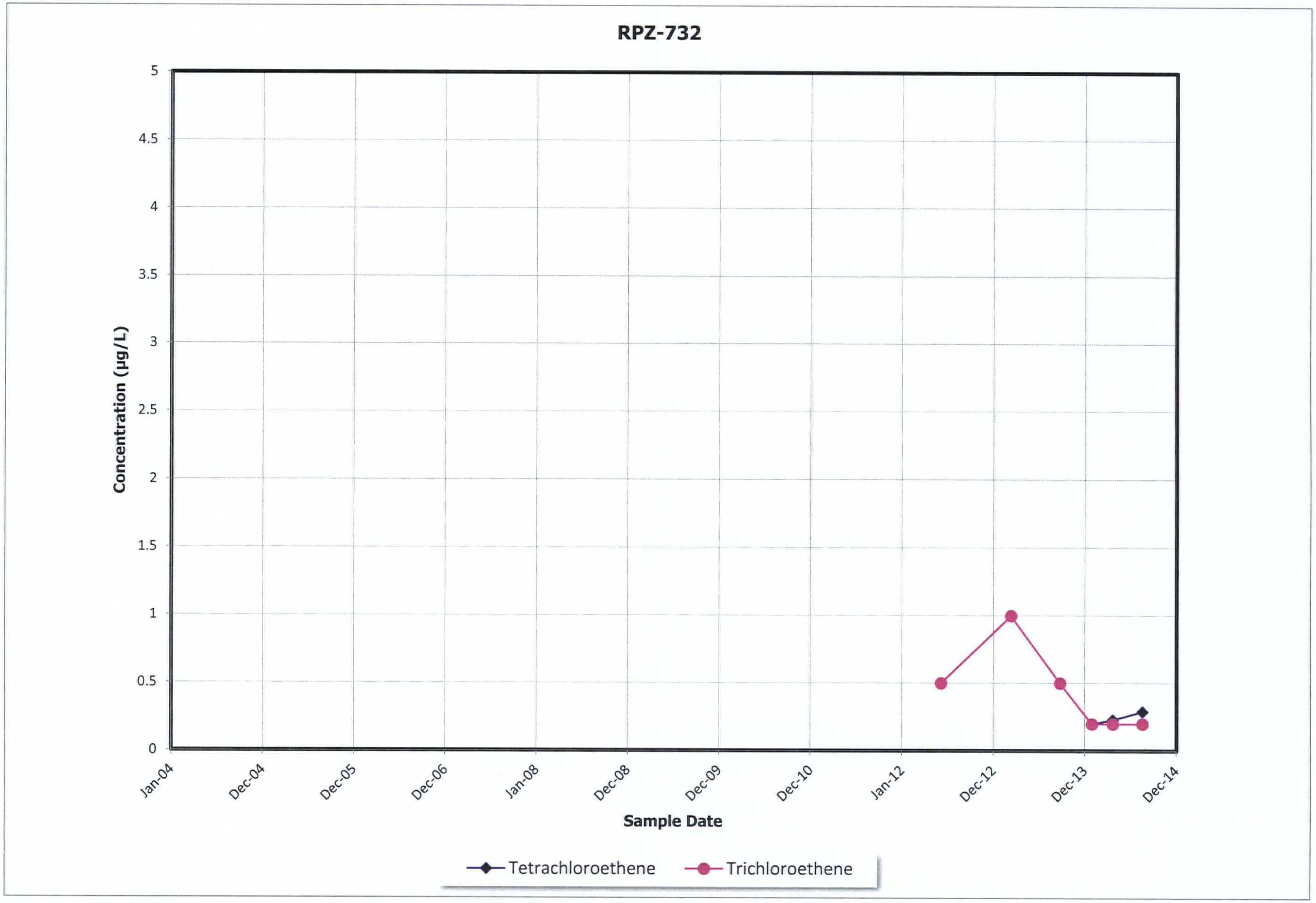


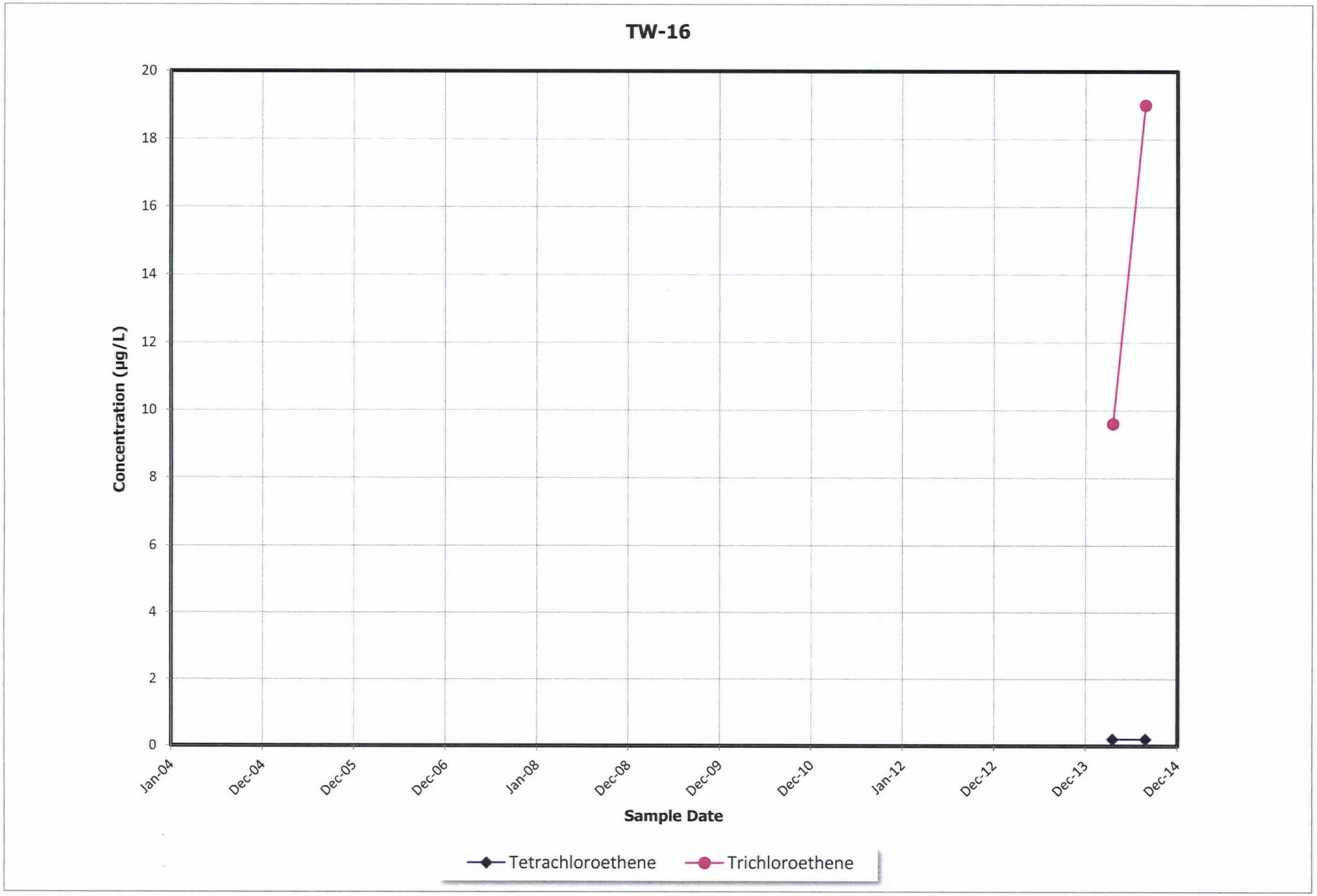
PZ-728
Concentration (µg/L)
60
50
40
30
20
10
0
Jan-04
Dec-04
Dec-05
Dec-06
Jan-08
Dec-08
Dec-09
Dec-10
Jan-12
Dec-12
Dec-13
Dec-14
Sample Date
Tetrachloroethene
Trichloroethene

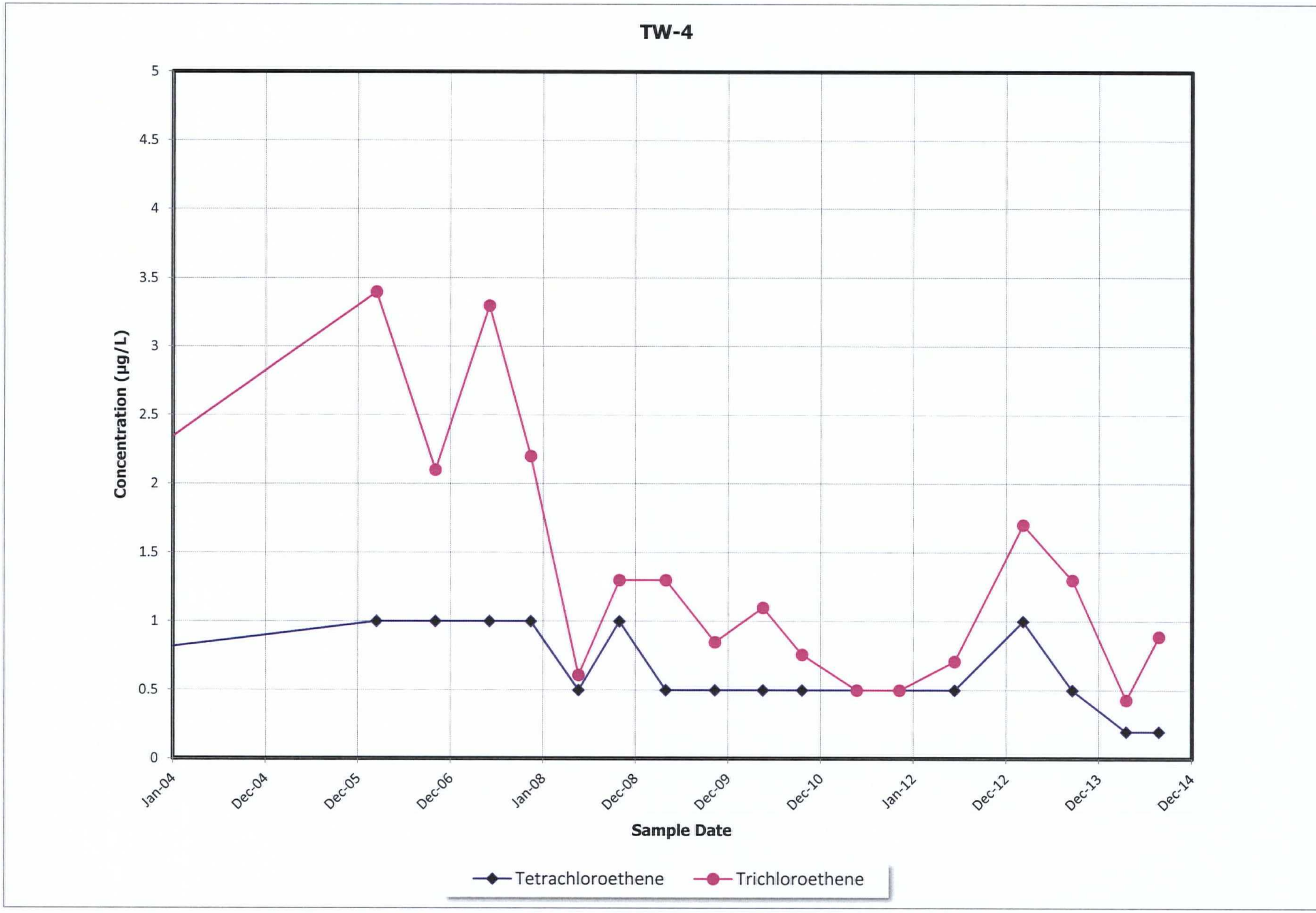

RPZ-730
Concentration (µg/L)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
Jan-04
Dec-04
Dec-05
Dec-06
Jan-08
Dec-08
Dec-09
Dec-10
Jan-12
Dec-12
Dec-13
Dec-14
Sample Date
Tetrachloroethene
Trichloroethene

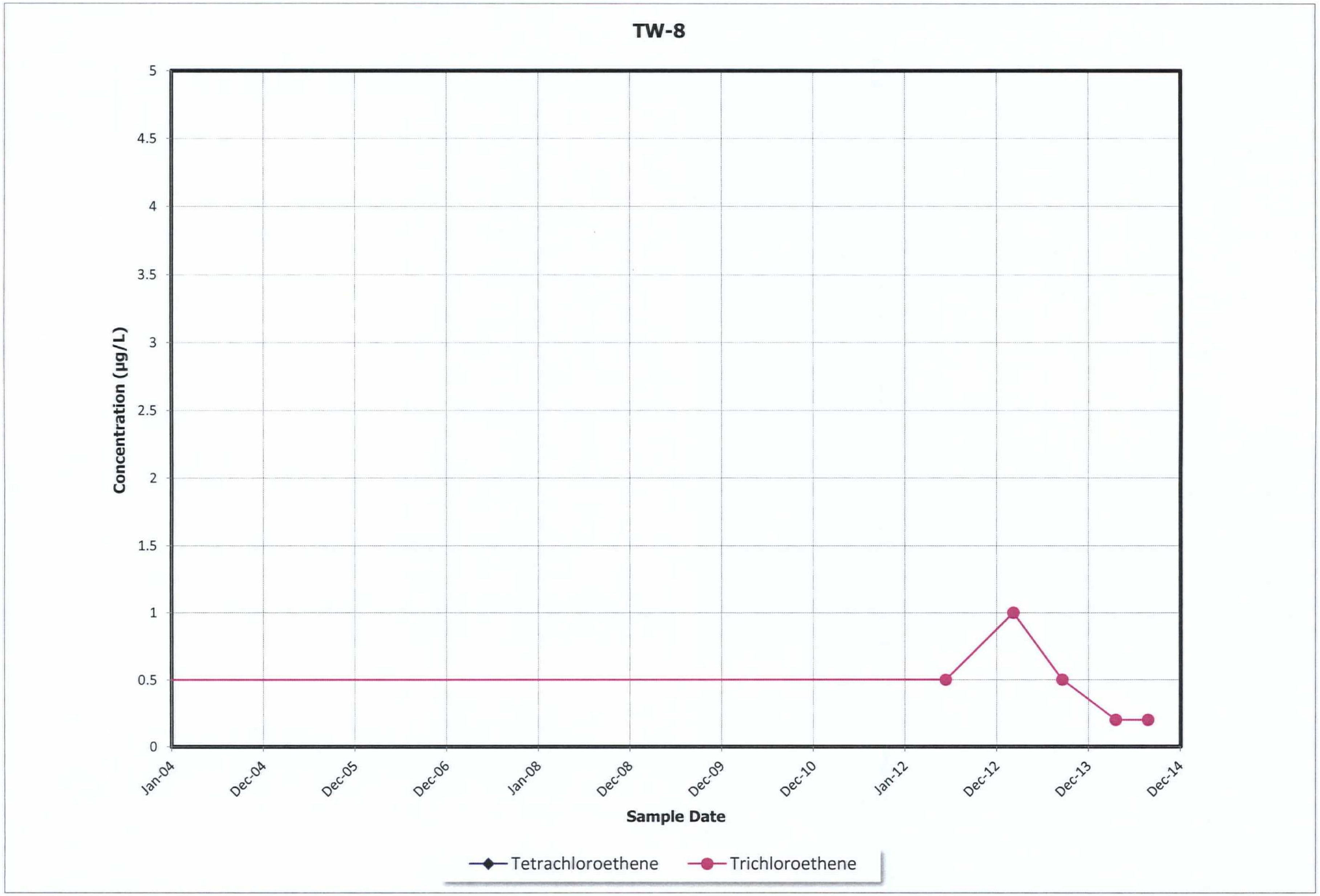


RPZ-731
Concentration (µg/L)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
Jan-04
Dec-04
Dec-05
Dec-06
Jan-08
Dec-08
Dec-09
Dec-10
Jan-12
Dec-12
Dec-13
Dec-14
Sample Date
Tetrachloroethene
Trichloroethene

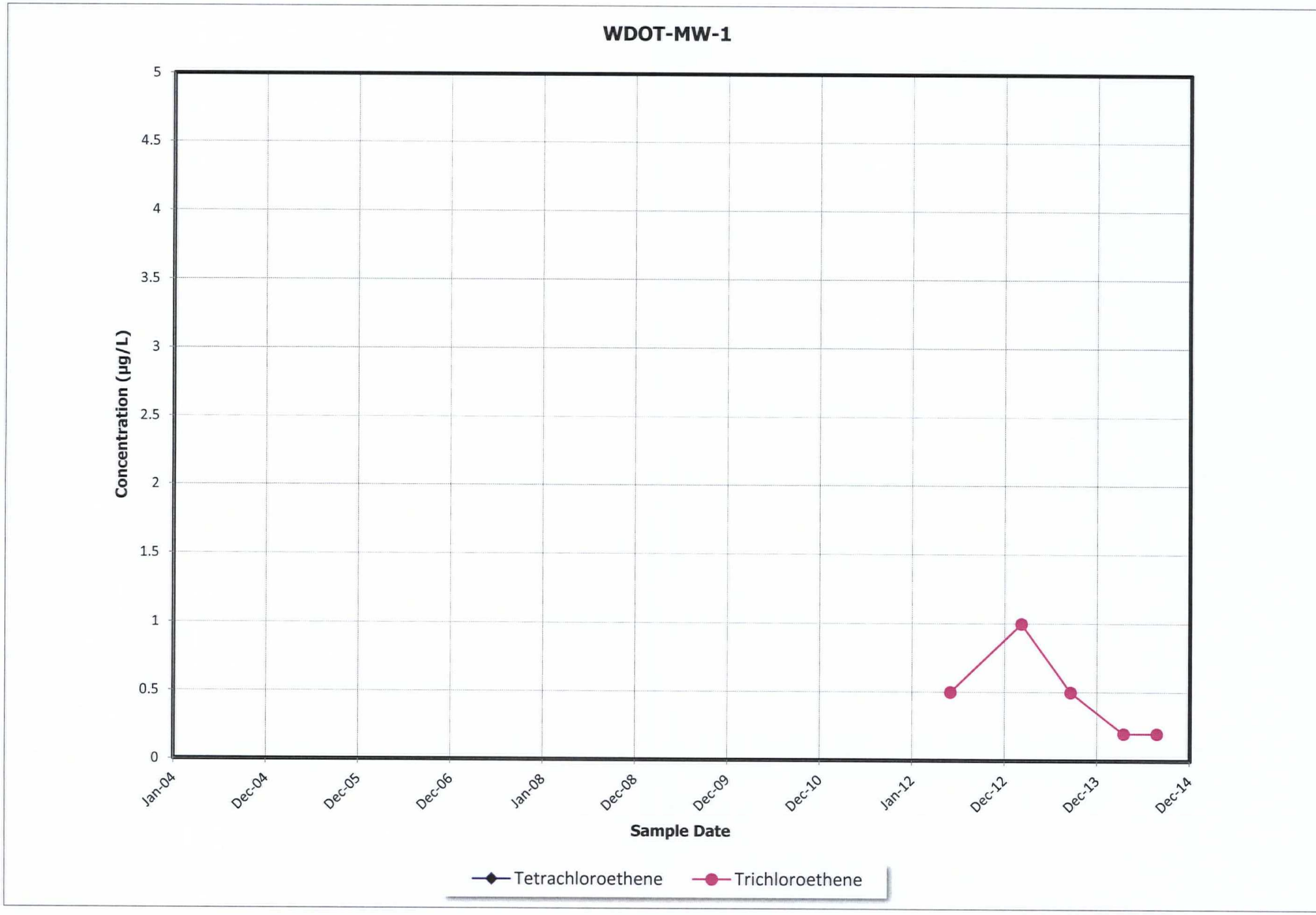

RPZ-732
Concentration (µg/L)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Jan-04
Dec-04
Dec-05
Dec-06
Jan-08
Dec-08
Dec-09
Dec-10
Jan-12
Dec-12
Dec-13
Dec-14
Sample Date
Tetrachloroethene
Trichloroethene


TW-16
Concentration (µg/L)
20
18
16
14
12
10
8
6
4
2
0
Jan-04
Dec-04
Dec-05
Dec-06
Jan-08
Dec-08
Dec-09
Dec-10
Jan-12
Dec-12
Dec-13
Dec-14
Sample Date
Tetrachloroethene
Trichloroethene

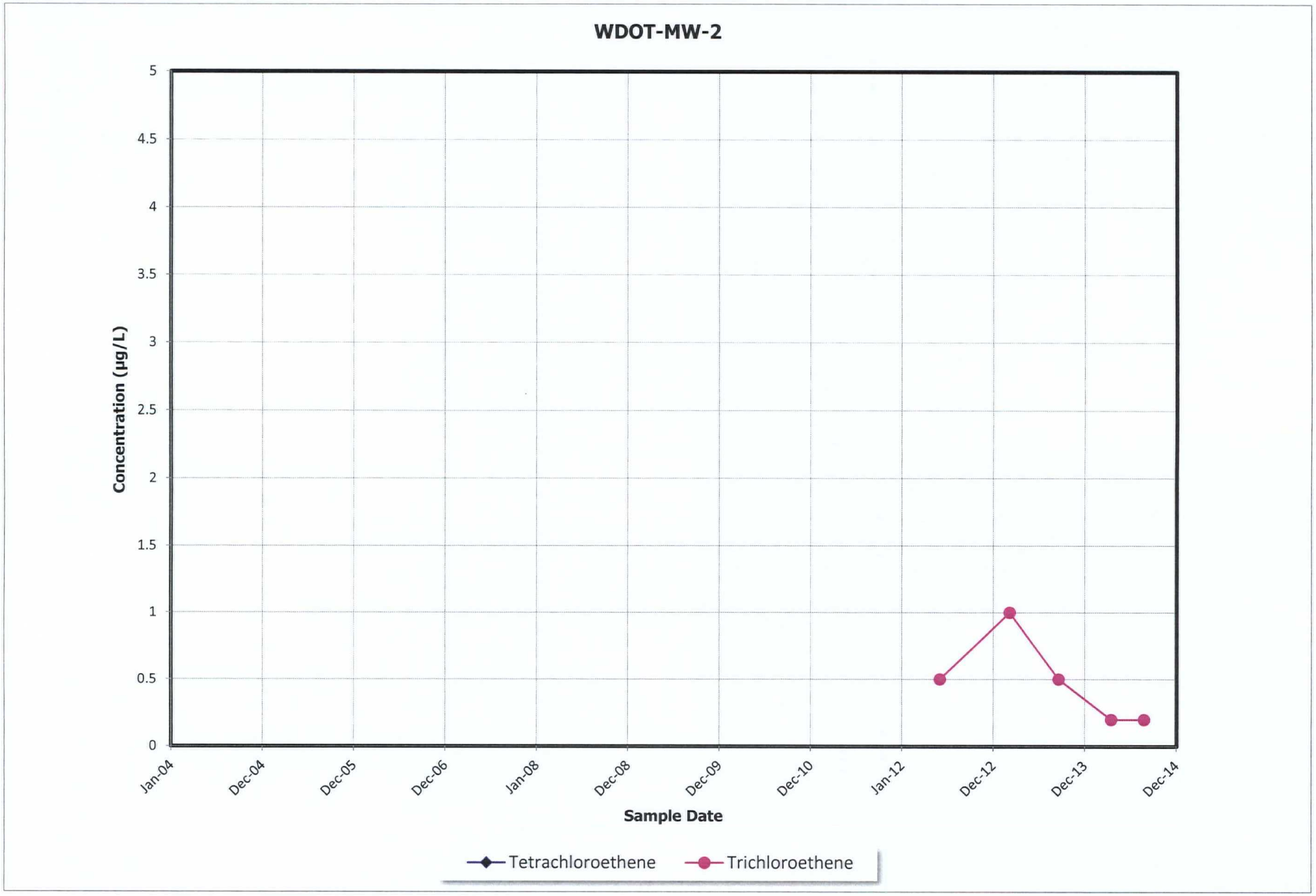

TW-4
Concentration (µg/L)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Jan-04
Dec-04
Dec-05
Dec-06
Jan-08
Dec-08
Dec-09
Dec-10
Jan-12
Dec-12
Dec-13
Dec-14
Sample Date
Tetrachloroethene
Trichloroethene



TW-8
Concentration (µg/L)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Jan-04
Dec-04
Dec-05
Dec-06
Jan-08
Dec-08
Dec-09
Dec-10
Jan-12
Dec-12
Dec-13
Dec-14
Sample Date
Tetrachloroethene
Trichloroethene



WDOT-MW-1
Concentration (µg/L)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Jan-04
Dec-04
Dec-05
Dec-06
Jan-08
Dec-08
Dec-09
Dec-10
Jan-12
Dec-12
Dec-13
Dec-14
Sample Date
Tetrachloroethene
Trichloroethene



WDOT-MW-2
Concentration (µg/L)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Jan-04
Dec-04
Dec-05
Dec-06
Jan-08
Dec-08
Dec-09
Dec-10
Jan-12
Dec-12
Dec-13
Dec-14
Sample Date
Tetrachloroethene
Trichloroethene

APPENDIX F
Capture Zone Analysis

APPENDIX F
PRELIMINARY CAPTURE ZONE ANALYSIS

The following section provides a description of the preliminary evaluation for capturing the TCE and PCE plumes utilizing the current remedial technology at the Wellfield. This section is organized to generally follow the EPA guideline for capture zone evaluations (EPA, 2008). The guideline suggests six key steps for systematically performing a capture zone evaluation:

1. Review site data, site conceptual model, and remedy objectives
2. Define site-specific Target Capture Zone(s)
3. Interpret water levels
4. Perform calculations
5. Evaluate concentration trends
6. Interpret actual capture based on Steps 1-5, compare to Target Capture Zone(s), assess uncertainties and data gaps

Because the current existing chemical analytical data set is not complete and a data gaps investigation is pending, Step 5 was not performed as part of this preliminary capture zone analysis. Steps 1 through 4 and 6 are described below. This capture zone evaluation is considered preliminary to assess the feasibility of using the existing Wellfield remedial technologies to capture, pump and treat all VOC plumes associated with the Site.

Review Site Data, Site Conceptual Model, and Remedy Objectives

Previous sections described in detail the extent of the Site data and the current conceptual model. One remedy objective would be to capture each VOC plume by pumping the Wellfield at a rate that would match the groundwater flow rate through the area of each plume and thereby capturing each plume. The impacted groundwater pumped from the wells would be treated utilizing the same remedial technologies that are currently installed and operating for approximately the last 13 years.

It is our understanding through communication with the City that the Wellfield is currently operated on intermittent schedules. The Wellfield is currently operated when the City is in need of supplemental drinking water capacity and is not continuously operated year round.

Plume Delineation

The plume zone targeted for this preliminary capture zone analysis was delineated using the contour of 5 μg/L TCE based on data collected during the Spring 2014 monitoring event, as presented on Figure F-1 as the Target Capture Zone. Figure F-1 shows that the plume extents from the west at MW-U1 at the former WSDOT MTL to the east at TW-16 within the Wellfield. The plume zone depicted on Figure F-1 has also been simplified to include all three VOC plumes from the current and former WSDOT MTL and Southgate Dry Cleaner properties.

Hydrogeologic Information

Two regional aquifer systems are assumed within the Site. The uppermost aquifer system is the Deschutes River Alluvium and the Vashon Drift. This system is considered to be unconfined (Vashon Drift in the uplands) to semi-confined (Deschutes River Alluvium in the valley). The Wellfield wells are completed within the Deschutes River Alluvium at depths ranging from 70 to 110 feet bgs. Static water levels within the Wellfield wells are generally less than 10 feet bgs.

A uniform thickness of 80 feet for an unconfined aquifer was used in the analysis. Aquifer transmissivities based on the results from pumping tests conducted at the Wellfield range from 23,900 gallons per day per foot (gpd/ft), equivalent to 3,195 feet squared per day (ft^2/day) at TW-17 to 89,000 gpd/ft (11,900 ft^2/day) at Well 8 (PGG, 1992). Thus, the hydraulic conductivity ranged from 300 to 1,100 gpd/ft^2 (40 to 150 feet per day [ft/day]). Scenarios using the low and high transmissivities without spatial variations were analyzed.

The groundwater elevation contours developed based on the Spring 2014 monitoring event were used to evaluate the groundwater flow directions and gradient. Groundwater flow across the study area is generally west to east, with a hydraulic gradient of approximately 0.025 to 0.03 feet per foot (ft/ft).

Currently, only Wellfield wells TW-4, TW-6 and TW-8 are actively pumped by the City. Historical average pumping rates of these existing wells are based on hourly pumping data obtained from the City and are listed in Table F-1. The maximum rate shown on Table F-1 is based on the maximum rate that was sustained for the wells pumping over a period of 4 to 6 hours.

TABLE F-1. CURRENT (2012) AVERAGE AND MAXIMUM SUSTAINED PUMPING RATES (GPM) FOR ACTIVE PALERMO WELLFIELD WELLS AND PROPOSED RATES FOR NEW WELLS, TW-16 AND TW-17

TW-4 (Average/ Maximum)	TW-6 (Average/ Maximum)	TW-8 (Average/ Maximum)	TW-16 (Average/ Maximum)	TW-17 Average/ Maximum)
84/190	172/390	120/280	–/400	–/350

Two Wellfield wells, TW-16 and TW-17, were drilled and installed in 2012 and 2014, respectively. The recommended pumping rates for TW-16 and TW-17 are 400 and 350 gpm, respectively. Wells TW-2 and TW-5 were decommissioned during 2012 and 2013 (PGG, 2013 and 2014). Locations of the Wellfield wells are shown in Figure F-1. Note that TW-6 and TW- 8 are located south and crossgradient to the target plume zone.

Conceptual Model

The preliminary conceptual model is described in Section 2 of the Revised Draft Summary of Existing Information Report. This model was simplified for the capture zone analysis by assuming each plume and the Wellfield are located in one aquifer with a uniform gradient and homogeneous aquifer parameters as described above.

Define Site-Specific Target Capture Zone(s)

The site-specific target capture zone is the TCE-impacted groundwater defined by the 5 μg/L TCE concentration contour as described in the Plume Delineation section described above. The width of the plume that must be captured by pumping the Wellfield is approximately 800 feet. The target capture zone was enlarged to 900 feet to include the zone directly upgradient of the actively pumped Wellfield wells TW-6 and TW-8, which are located south and crossgradient to the plume.

Interpret Water Levels

The water level data and the potentiometric surface maps developed are described above. Seasonal or annual differences in the groundwater elevations were not evaluated for this capture zone analysis, which used an average uniform gradient of 0.028 ft/ft based on the most recent monitoring event in Spring of 2014.

Perform Calculations

Two calculations were performed that are based on the capture zone analysis guidelines provided by EPA (2008). The calculations were as follows:

- Estimation of groundwater flow-through in the aquifer through the area of the plumes (capture zone), and
- Estimation of the width of the capture zone that intercept the flow-through.

Flow Rate Calculation

The estimated flow rate calculation provides an estimate for the pumping required to capture a plume based on the rate of groundwater flow through the plume extent. Assumptions for this approach include the following:

- homogeneous, isotropic, confined aquifer of infinite extent
- uniform aquifer thickness
- fully penetrating extraction well(s)
- uniform regional horizontal hydraulic gradient
- steady-state flow
- negligible vertical gradient
- no net recharge, or net recharge is accounted for in regional hydraulic gradient
- other sources of water introduced to aquifer due to extraction.

The estimated flow rate under these conditions can be calculated by (EPA, 2008):

$$Q = K \cdot b \cdot w \cdot i \cdot f \qquad (E.1)$$

Or, because T = K · b

$$Q = T \cdot w \cdot i \cdot f \qquad (E.2)$$

Where:

Q = extraction rate (ft^3/day)

K = hydraulic conductivity (ft/day)

b = saturated thickness (ft)

$T = K \cdot b$ transmissivity (ft/day)

w = plume width (ft)

i = regional (i.e., without remedy pumping) hydraulic gradient (ft/ft)

f = "factor", "rule of thumb" is 1.5 to 2.0, intended to account for other contributions to the pumping well such as flux from a river or induced vertical flow from other stratigraphic units are represented by the "factor". In this analysis, three scenarios of the factor value are selected:

- 1.0,
- 1.5, and
- 2.0.

By using Equation E.2, we can ignore the assumption of confined aquifer and uniform aquifer thickness, and use the range of variable transmissivity, *T*, obtained from the pumping tests, representing the variation of both aquifer thickness *b* and hydraulic conductivity, *K*. In this analysis, three scenarios of *T* are selected:

- 23,900 gpd/ft (3,195 ft^2/day), the low transmissivity,
- 50,670 gpd/ft (6,774 ft^2/day) the average of the low and high range of transmissivities, and
- 89,000 gpd/ft (11,898 ft^2/day), the high transmissivity.

For the present study site, the regional hydraulic gradient, *i*, ranges from 0.025 to 0.03 ft/ft. For this preliminary analysis, an average hydraulic gradient value of 0.028 ft/ft was used. Based on Figure F-1, the maximum width, *w*, of the 5 μg/L concentration that defines the target capture zone is approximately 800 feet. This width was increased to 900 feet to include the upgradient area of Wellfield actively pumped wells TW-6 and TW-8. The estimated flow rates, *Q*, through the TCE plume width, for various combinations of parameter values, are given in Table F-2:

TABLE F-2. ESTIMATED FLOW RATE CALCULATION[1]

Factor	Transmissivity (ft^2/day)	Estimated Flow Rate[1] (ft^3/day)	Estimated Flow Rate (gpm)
1	3,195	71,568	372
	6,774	151,738	788

Factor	Transmissivity (ft²/day)	Estimated Flow Rate[1] (ft³/day)	Estimated Flow Rate (gpm)
	11,898	266,515	1,384
1.5	3,195	107,352	558
	6,774	227,606	1,182
	11,898	399,773	2,077
2	3,195	143,136	744
	6,774	303,475	1,576
	11,898	533,030	2,769

Note:

[1] Based on estimated plume width of 900 ft and regional hydraulic gradient of 0.028 ft/ft.

Capture Zone Width Calculation

The width of the capture zone was estimated using the following assumptions:

- homogeneous, isotropic, confined aquifer of infinite extent,
- uniform aquifer thickness,
- fully penetrating extraction well(s),
- uniform regional horizontal hydraulic gradient,
- steady-state flow,
- negligible vertical gradient,
- no net recharge, or net recharge is accounted for in regional hydraulic gradient, and
- no other sources of water are introduced to aquifer due to extraction, the width of the capture zone can be obtained by solving the following equation (US EPA, 2008):

$$x = \frac{-y}{\tan\left(\frac{2\pi Ti}{Q}y\right)} \qquad \text{(E.3)}$$

to obtain:

$$X_0 = \frac{-Q}{2\pi Ti}, \qquad \text{(E.4)}$$

$$Y_{\max} = \frac{\pm Q}{2Ti}, \qquad \text{(E.5)}$$

and

$$Y_{well} = \frac{\pm Q}{4Ti}. \qquad \text{(E.6)}$$

where,

Q = extraction rate (ft^3/day)

$T = K \cdot b$, transmissivity (ft^2/day)

K = hydraulic conductivity (ft/day)

b = saturated thickness (ft)

i = regional (i.e., pre-remedy-pumping) hydraulic gradient (ft/ft)

X_0 = distance from the well to the downgradient end of the capture zone along the central line of the flow direction (ft)

Y_{max} = maximum capture zone width from the central line of the plume (ft)

Y_{well} = capture zone width at the location of well from the central line of the plume (ft).

Note that this calculation assumes no other sources of water are introduced into the aquifer due to induced flow, such as from surface water or from an adjacent aquifer. When multiple extraction wells are present, this capture zone width calculation is typically applied by assigning the total extraction rate to one "equivalent well". The location of the equivalent well is generally selected visually so it is centrally located with respect to the plume width and/or extraction well locations, and located at the most downgradient position of the actual extraction wells. For this analysis, the equivalent well was located central to the actively pumped extraction wells, TW-4, TW-6 and TW-8. This represents a significant level of simplification for a multi-well extraction system.

For this study, three pumping scenarios were used to estimate the capture zone.

1. Scenario 1 – currently active wells are pumped at their typical average pumping rates based on 2012 hourly pumping rate data obtained from the City. The average rate totals 376 gpm, consisting of 86 gpm from TW-4, 172 gpm from TW-6 and 120 gpm from TW-8. Scenario 1 represents estimated current pumping conditions to show the current capture zone. The "equivalent well" is centrally located relative to TW-4, TW-6 and TW-8.
2. Scenario 2 – currently active wells pumped continuously at their maximum rate. The rate for this scenario is 860 gpm, consisting of 190 gpm from TW-4, 390 gpm from TW-6 and 280 gpm from TW-8. Scenario 2 represents a maximum capture zone using only the currently active wells. The "equivalent well" is located the same as Scenario 1.
3. Scenario 3 – proposed use of TW-4 plus recently constructed TW-16 and TW-17 and pumping all three continuously at their recommended long-term production rates. The rate for this scenario is 940 gpm, consisting of 190 gpm from TW-4, 400 gpm from TW-16 and 350 gpm from TW-17. Scenario 3 represents a maximum capture zone using only the proposed future production wells. Also, the "equivalent well" is centrally located relative to TW-4, TW-16 and TW-17.

Calculations for Y_{well} ,Y_{max}, and X_0 for different possible combinations of pumping rate and transmissivity values are presented in Table F-3. The capture zones for all three scenarios using the average transmissivity are shown on Figure F-2. Additionally, the capture zones for Scenario 3 for the high and low range of transmissivities are shown on Figure F-2. The capture zone extents shown on Figure F-2 are in bold on Table F-3.

TABLE F-3. ESTIMATED FLOW RATE CALCULATIONS[1]

Pumping Rate Scenarios (gpm)	Transmissivity (ft^2/day)	X_o (ft)	Y_{well} (ft)	Capture Zone Width at Wells (ft)	Y_{max} (ft)	Max Capture Zone Width Upgradient (ft)
376	3,195	129	202	405	405	809
	6,774	61	95	191	191	**382**
	11,898	35	54	109	109	217
860	3,195	295	463	925	925	1,851
	6,774	139	218	436	436	**873**
	11,898	79	124	248	248	497
940	3,195	322	506	1,011	1,011	**2,023**
	6,774	152	239	477	477	**954**
	11,898	86	136	272	272	**543**

Compare Actual to Targeted Capture Zones

Even with limited existing information for this preliminary capture zone analysis, it is apparent that the capture zone for the current average pumping rates for the actively pumped wells, Scenario 1, is located almost too far south and is not wide enough to capture the targeted capture zone, the three VOC plumes. This suggests that portions of each plume could be escaping to the east beyond the Wellfield. The likelihood that the Site plumes are fully captured is further reduced because the Wellfield is currently not operated on a continuous schedule.

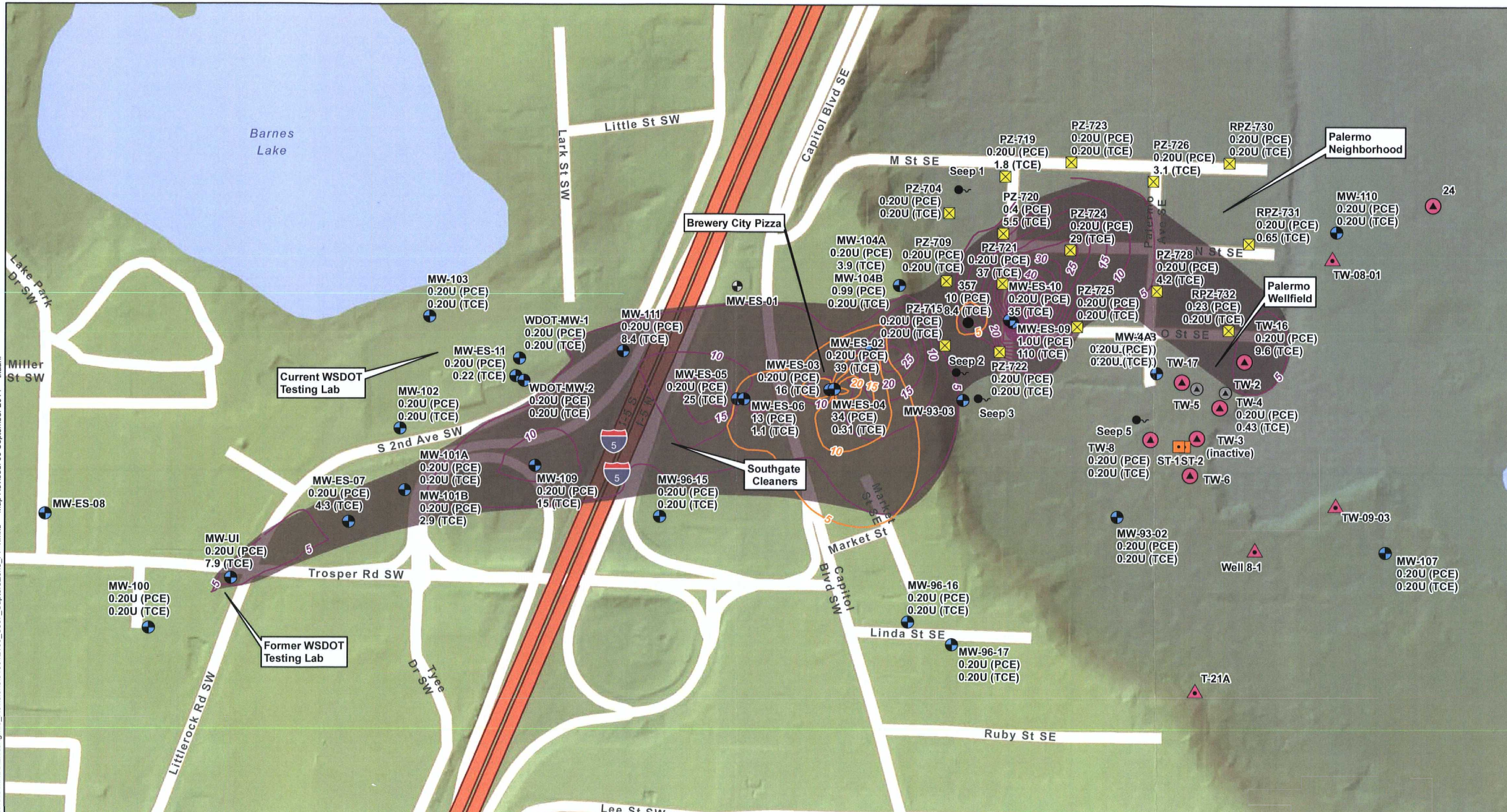
The capture zone for the maximum pumping rates for the actively pumped wells, Scenario 2, is larger and captures a larger percentage of the targeted capture zone. However, this pumping scenario still does not obtain full capture of the north portion of the Site plumes.

The capture zone for the proposed pumping of Wellfield wells TW-4, TW-16 and TW-17, Scenario 3, is apparently more effective than Scenarios 1 and 2. Using the high-range transmissivity for Scenario 3, the capture zone essentially matches the effectiveness of Scenario 2, with additional capture within the eastern extent of the plume. Using the mid-range transmissivity for Scenario 3, the capture zone appears to capture a significant portion of the plume. The capture zone for the low-range transmissivity of Scenario 3 indicates that there potentially would be nearly full capture of the Site plumes, if the Wellfield is operated on a continuous basis.

Summary and Conclusions

As part of evaluating the nature and extent of TCE at the Site, a preliminary capture zone analysis was performed to assess potential pumping scenarios that could capture the existing Site plumes through existing pumping and treatment techniques. The analysis was conducting using hydrogeologic information available and summarized in previous sections of this Report. The key hydrogeologic elements used for the capture zone analysis included a delineation of an area of TCE impact that encompasses the identified three VOC plumes, a groundwater elevation contour map based on the Spring 2014 monitoring event, aquifer parameters based on the analysis done by others of pumping tests conducted on the Wellfield wells, and historical pumping rates obtained from the City.

The preliminary capture zone analysis was conducted using three pumping scenarios for the Wellfield based on current average pumping rates, a maximum rate using currently actively pumped wells, and a maximum pumping rate for a proposed future usage. The results of the analysis indicated that the plume would not be entirely captured at the current usage rates. The analysis did indicate that, depending on the actual transmissivity of the aquifer, the full targeted capture zone could be obtained by pumping TW-4, TW-16 and TW-17 continuously at a maximum rate.



Data Source: Base Map from ESRI Street Map data, 2013.
Hillshade created from Puget Sound Lidar Consortium Lidar (collected 2002).
Projection: NAD 1983 StatePlane Washington South FIPS 4602 Feet

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. TW-3, TW-16 and TW-17 are installed but not operating.
4. Groundwater elevations collected April 14, 2014.
5. Groundwater elevation estimated using Surfer (Golden Software) 8.0 contouring software using the Natural Neighbor gridding method.
6. Groundwater elevations are relative to NGVD 29 datum.

Legend:
- PCE Contours (5 µg/l interval)
- TCE Contours (5 µg/l interval)
- Monitoring well and identifier
- Piezometer and identifier
- Groundwater seep and identifier
- City production well and identifier
- City test well and identifier
- Stripper tower and identifier
- Former city production well and identifier
- Former monitoring well and identifier
- Cleanout location and identifier
- Target Capture Zone

N E S W

300 0 300
Feet

Target Capture Zone

Summary of Existing Information Report
Palermo Wellfield Superfund Site

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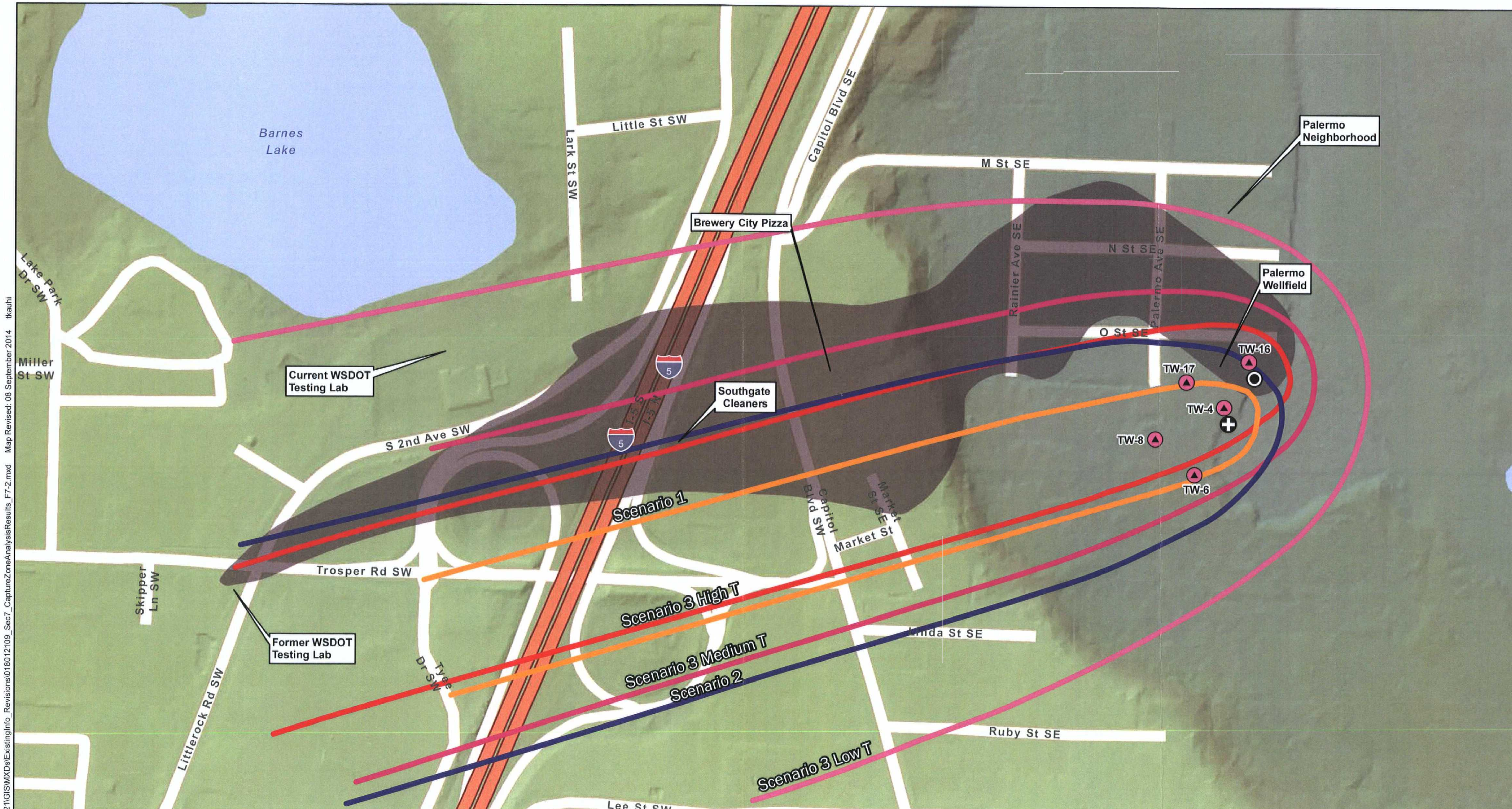
Figure F-1

Office: TAC Path: \\TACprojects\0\0180121\GIS\MXDs\ExistingInfo_Revisions\0180121109_Sec7_CaptureZone_F7-1.mxd Map Revised: 08 September 2014 tkauhi



Data Source: Base Map from ESRI Street Map data, 2013.
Hillshade created from Puget Sound Lidar Consortium Lidar (collected 2002).
Projection: NAD 1983 StatePlane Washington South FIPS 4602 Feet

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. TW-16 and TW-17 are installed but not operating.

City production well and identifier
Target Capture Zone
Equivalent Well for Scenarios 1 and 2
Equivalent Well for Scenario 3

Scenario 1
Scenario 2
Scenario 3 Low T
Scenario 3 Medium T
Scenario 3 High T

N W E S

300 0 300
Feet

Capture Zone Analysis Results

Summary of Existing Information Report
Palermo Wellfield Superfund Site

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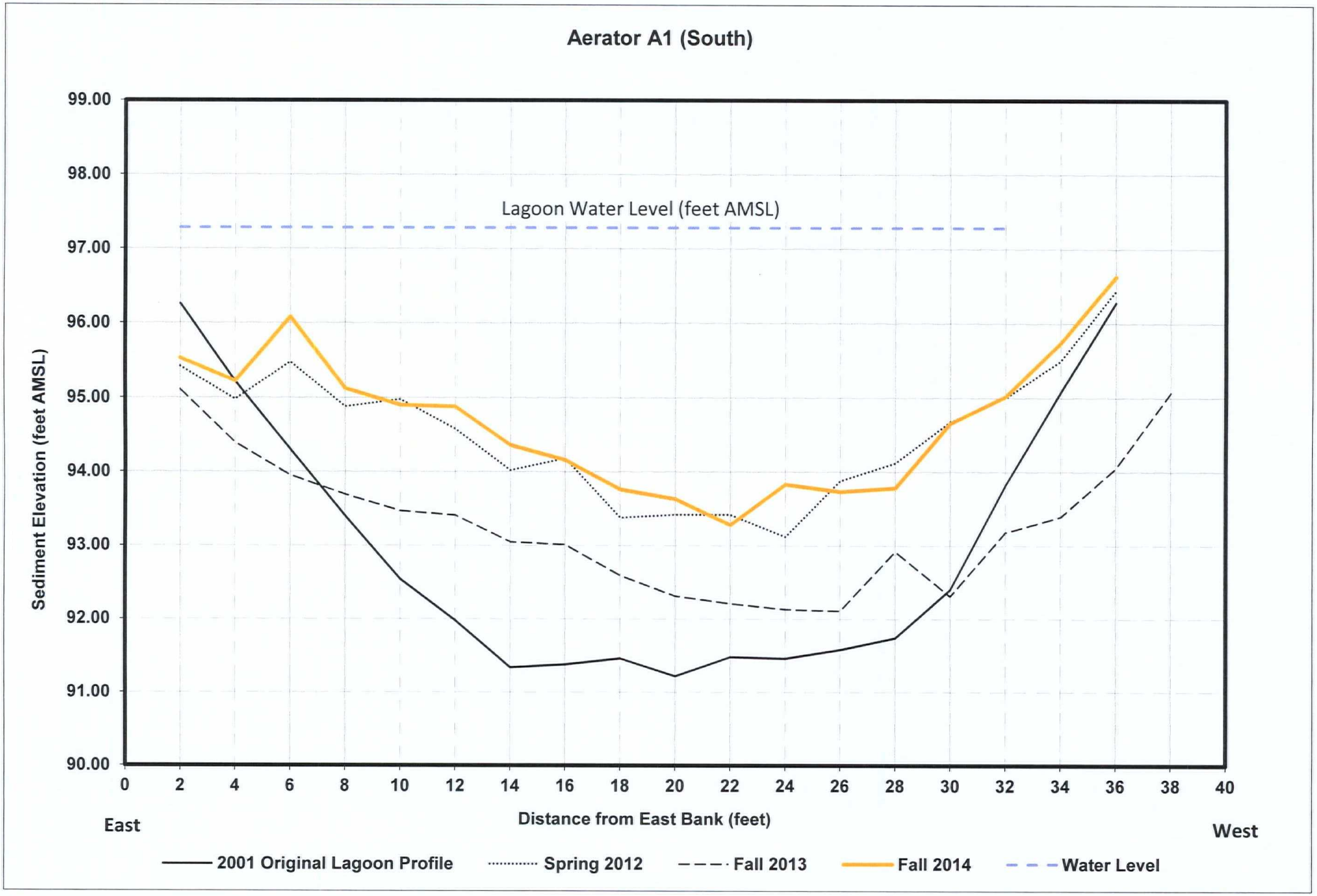
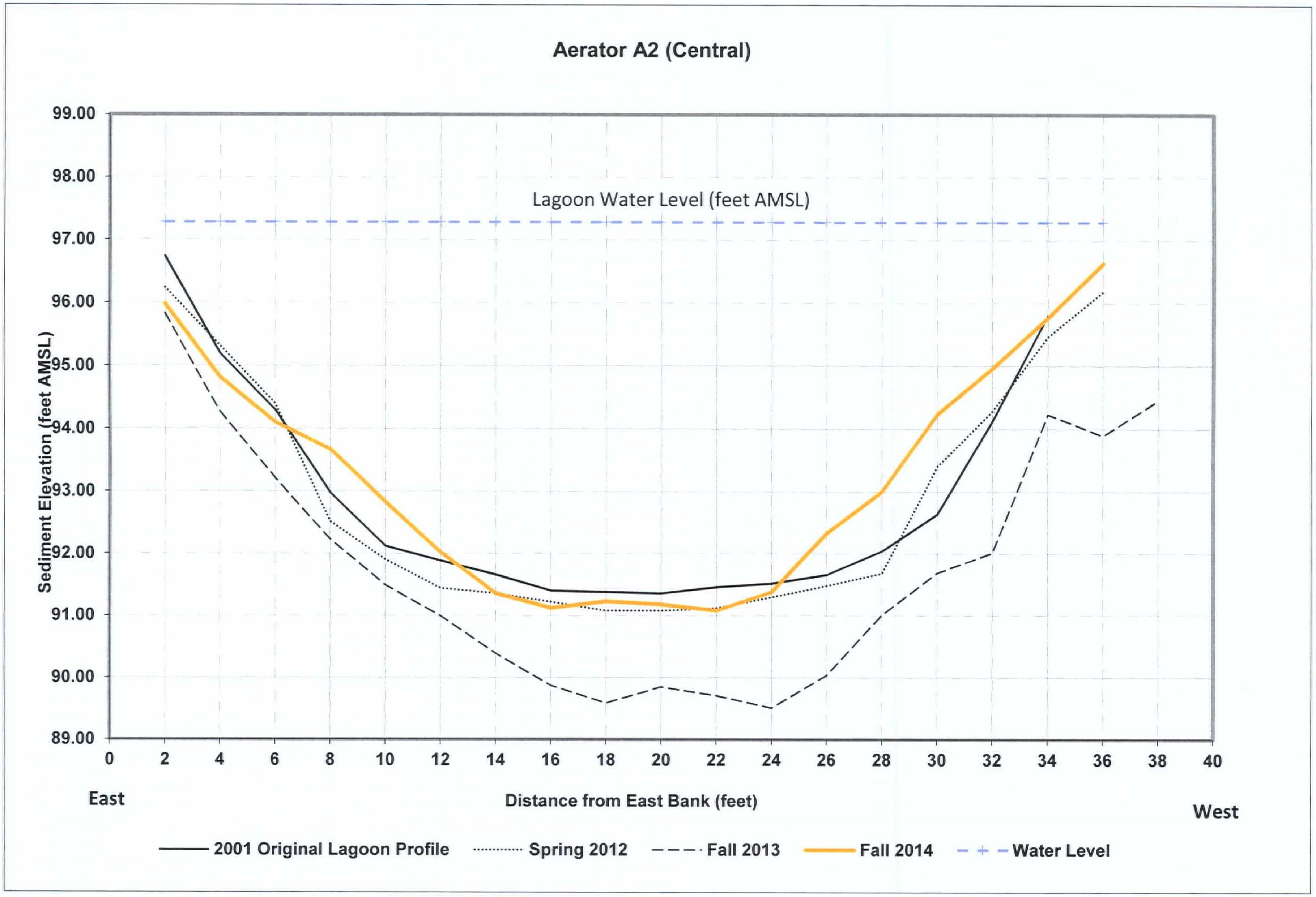
Figure F-2

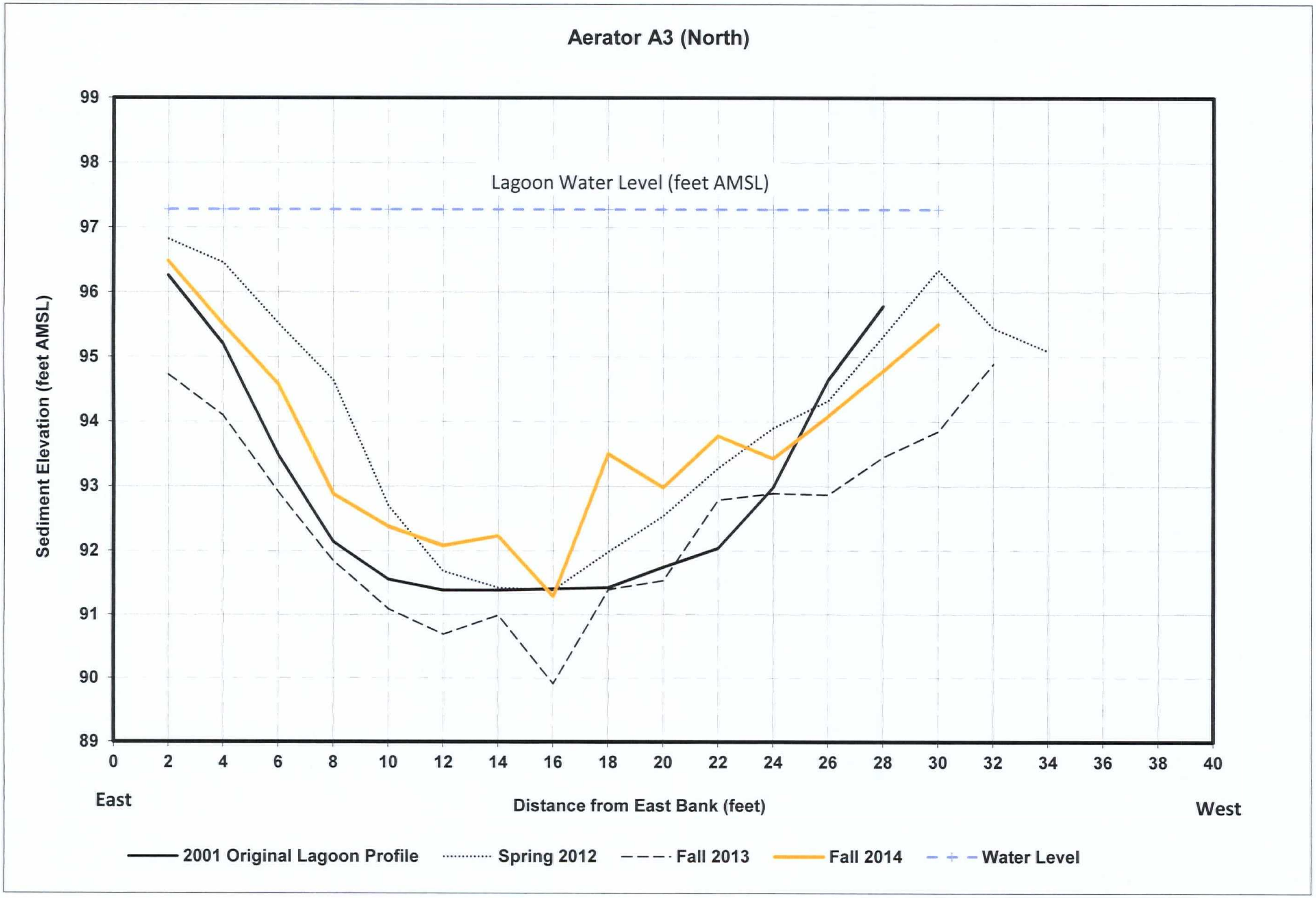
Office: TAC Path: \\TAC\projects\0\0180121\GIS\MXDs\ExistingInfo_Revisions\018012109_Sec7_CaptureZoneAnalysisResults_F7-2.mxd Map Revised: 08 September 2014 tkauhi

APPENDIX G
Lagoon Transects



Aerator A1 (South)
Lagoon Water Level (feet AMSL)
Sediment Elevation (feet AMSL)
99.00
98.00
97.00
96.00
95.00
94.00
93.00
92.00
91.00
90.00
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
East
Distance from East Bank (feet)
West
2001 Original Lagoon Profile
Spring 2012
Fall 2013
Fall 2014
Water Level


Aerator A2 (Central)
Lagoon Water Level (feet AMSL)
Sediment Elevation (feet AMSL)
99.00
98.00
97.00
96.00
95.00
94.00
93.00
92.00
91.00
90.00
89.00
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
East
Distance from East Bank (feet)
West
2001 Original Lagoon Profile
Spring 2012
Fall 2013
Fall 2014
Water Level


Aerator A3 (North)
Lagoon Water Level (feet AMSL)
Sediment Elevation (feet AMSL)
99
98
97
96
95
94
93
92
91
90
89
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
East
Distance from East Bank (feet)
West
2001 Original Lagoon Profile
Spring 2012
Fall 2013
Fall 2014
Water Level

APPENDIX H
Report Limitations and Guidelines for Use

APPENDIX H
REPORT LIMITATIONS AND GUIDELINES FOR USE

This appendix provides information to help you manage your risks with respect to the use of this report.

Report Use and Reliance

This report has been prepared for the Washington State Department of Transportation and can be distributed to Client's authorized agents and regulatory agencies as needed for the project.

GeoEngineers structures our services to meet the specific needs of our clients. Accordingly, no party other than the Washington State Department of Transportation may rely on the product of our services unless we agree to such reliance in advance and in writing. Within the limitations of scope, schedule and budget, our services have been executed in accordance with our Agreement with the Client for this project and generally accepted environmental practices in this area at the time this report was prepared.

This report should not be applied for any purpose or project except the one originally contemplated. If important changes are made to the project or property after the date of this report, we recommend that GeoEngineers be given the opportunity to review our interpretations and recommendations, and then we can provide written modifications or confirmation, as appropriate.

Information Provided by Others

GeoEngineers has relied upon certain data or information provided or compiled by others in the performance of our services. Although we used sources that are believed to be trustworthy, GeoEngineers cannot warrant or guarantee the accuracy or completeness of information provided or compiled by others.

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